

**RCRA/ACT 64 OPERATING
LICENSE RENEWAL APPLICATION**

FORD

**FORD MOTOR COMPANY
ALLEN PARK CLAY MINE LANDFILL
ALLEN PARK, MICHIGAN**

**VOLUME III
SUPPLEMENTAL INFORMATION**

NOVEMBER 1993

EPA ID NO. MID980568711

**FORD MOTOR COMPANY
ACT 64 OPERATING LICENSE RENEWAL APPLICATION**

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Environmental and Safety Engineering Staff
Ford Motor Company

Suite 608
15201 Century Drive
Dearborn, Michigan 48120

May 19, 1989

Mr. Pete Quackenbush
Waste Management Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, Michigan 48909

Subject: Ford Allen Park Clay Mine Landfill
EPA ID No. MID 980568711

Dear Mr. Quackenbush:

As required in Part III Section C.1.b of the subject facility operating license, enclosed please find the PRELIMINARY CONSTRUCTION CERTIFICATION REPORT dated October 27, 1988. This report documents that Section V of the Construction Quality Assurance Plan was followed during the removal of water from the cell base.

Also enclosed for your approval is the plan for the TEST FILL CONSTRUCTION PROCEDURE as required in Part III Section C.1.c. of the subject facility operating license. This plan will demonstrate that the liner design can be constructed and will perform in accordance with the approved plans.

Should you have any questions regarding this matter, please contact Mr. David Miller of this Office at 313/322-0700.

Yours truly,

A handwritten signature in cursive script that reads "Jerome S. Amber".

Jerome S. Amber
Principal Staff Engineer
Stationary Source Environmental
Control Office
313/322-4646

DSM

cc: Ardys Bennett

Allen Park Clay Mine Landfill
Hazardous Cell II - Preliminary Construction
Certification Report
October 27, 1988

In accordance with Part III, Section C.1.b. of the operating permit, the following information documents that the procedures stipulated in Section V.A.1.b. of the CQA plan were followed to this date.

The over-excavated area of Cell II was dewatered and brown clay fill was placed on the bottom of the cell between May 18 and May 28, 1987. A four-inch gas pump was used in the dewatering process and the clay fill was brought in by trucks from the I-696 Road excavation. The sidewalls of the cell were initially groomed with a Caterpillar D-7 bulldozer and a D-6 and D-8 bulldozers were brought in to move the clay into the cell bottom. The water elevation was maintained at 560 feet msl, while clay fill was used to surcharge the soft sediments towards the low point in the cell bottom. A Caterpillar 225 backhoe was used in the southwesterly portion of the cell to pull the wet sediments from the surcharging operation. These sediments were casts to higher ground and spread by a D-6 bulldozer for drying.

By May 28, 1987, the two bulldozers and the backhoe had completed the cleanup of cell bottom and placement of clay. No compaction tests were done at this time.

In mid-July, 1987, a temporary four-foot diameter sump was installed in the southwesterly area of the cell to facilitate and maintain pumping of stormwater in the cell bottom.

On June 10 and 14, 1988, some preliminary testing and clay fill thickness verification was made in the bottom of Cell II. A grid was placed in this area and checks on compaction were made using an approximate Modified Proctor value. These results indicated the clay fill was compacted to between 85 to 90 percent of the maximum dry density. These results are not acceptable and the clay fill will require removal and recompaction to proper density. No records of these tests were kept. Test holes were also made at these grid points that indicates 1.2 to 3.5 feet of clay backfill was placed in the over-excavated area.

Page Two
Allen Park Clay Mine
October 27, 1988

Attached is a drawing showing the test points and a data sheet with coordinates of the grid locations, existing ground elevations (top of clay fill), cuts and fills (C-F) to design elevations, and cuts and elevations of the in situ clay bottom. Samples of the brown clay fill were also retested for classification, grain size distribution, atterberg limits and Modified Proctor in a Neyer, Tiseo & Hindo, Ltd. report.

The next phase will require recompacting the clay fill in small sections prior to the staged subgrade preparation.

Danny L. Booth, P.E.

Michigan Registered
Professional Engineer No. 25593

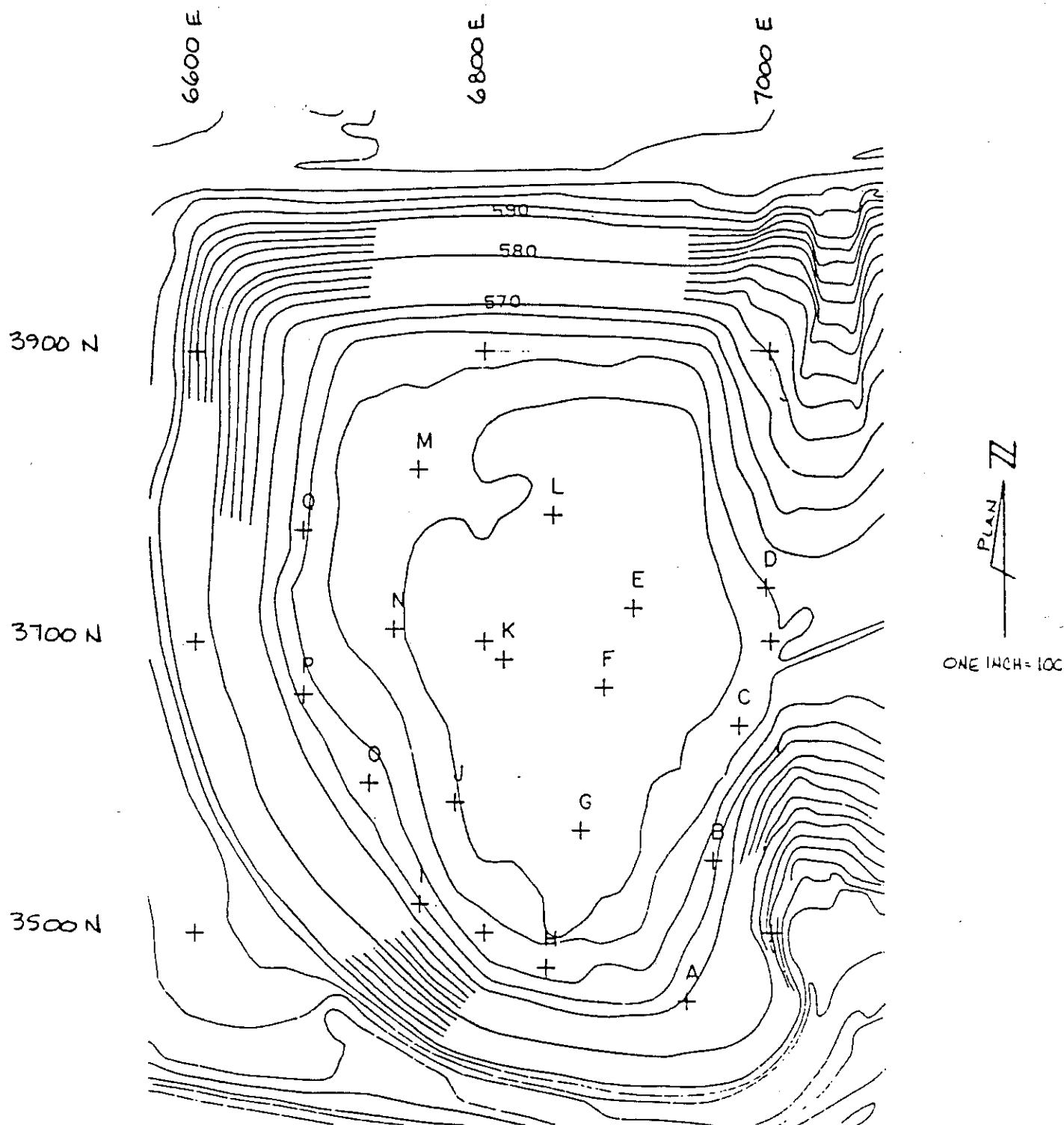
APCM - CELL 2

BOTTOM FILL CLAY

6/14/88 11:00 A.M.

	NORTHING	EASTING	GROUND ELEV.	CUT-FILL TO DESIGN	CUT TO INSITU CLAY	ELEV. OF INSITU CLAY
A	3452.9	7041.0	570.2	F 6.8	0.0	570.2
B	3549.4	7059.6	567.1	F 0.8	0.0	567.1
C	3641.7	7078.0	563.5	C 1.7	0.0	563.5
D	3736.4	7096.9	563.9	C 3.9	0.0	563.9
E	3722.6	7003.6	561.1	C 0.1	2.0	559.1
F	3668.0	6983.2	561.0	F 1.0	2.0	559.0
G	3569.8	6967.2	560.9	F 3.3	2.0	558.9
H	3519.1	6855.8	568.1	C 1.8	0.0	568.1
I	3475.6	6943.0	565.3	F 4.2	0.0	565.3
J	3589.0	6880.2	562.6	F 2.1	3.5	559.1
K	3687.1	6913.7	561.0	F 1.3	2.5	558.5
L	3786.4	6947.7	561.2	F 1.3	3.0	558.2
M	3817.7	6854.6	563.1	F 0.9	3.0	560.1
N	3708.0	6837.3	563.0	C 0.4	2.0	561.0
O	3602.2	6820.1	567.1	C 2.1	3.0	564.1
P	3663.2	6774.2	567.0	C 2.9	1.2	565.8
Q	3775.8	6773.9	566.9	C 2.9	3.5	563.4

WEATHER: HOT, 90 DEGREES FAHRENHEIT



FORD ALLEN PARK CLAY MINE
 HAZARDOUS CELL II LANDFILL
 TEST HOLE LOCATION MAP - JUNE 14, 1988
 AERIAL TOPG - APRIL 10, 1988
 D. BOOTH OCTOBER 27, 1988



NTH Consultants, Ltd.

SPECIFICATION NO. APCML91-5

TYPE I HAZARDOUS WASTE CELL CONSTRUCTION

ALLEN PARK CLAY MINE

ALLEN PARK, MICHIGAN

MID 980568711

SECTION D

Prepared For:

FORD MOTOR COMPANY

ENVIRONMENTAL QUALITY OFFICE

DEARBORN, MICHIGAN

Prepared By:

NTH CONSULTANTS, LTD.

NTH PROJECT NO. 13-9365-00 (13-89365 OW)

Issued June, 1989

Revised March 18, 1992

Professional Engineering & Environmental Services

**OFFICE
COPY**



SPECIFICATION NO. APCML91-5
TYPE I HAZARDOUS WASTE CELL CONSTRUCTION

ALLEN PARK CLAY MINE

ALLEN PARK, MICHIGAN

MID 980568711

SECTION D

Prepared For:

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NTH PROJECT NO. 13-9365-00 (13-89365 OW)

Issued June, 1989

Revised March 18, 1992

CONTRACT DOCUMENTS
HAZARDOUS WASTE CELL CONSTRUCTION
ALLEN PARK CLAY MINE
ALLEN PARK, MICHIGAN

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2. C.E. Raines, Drawing 79 p.23.6, Sht. C-3-Phase II APCM, Typical Drainage Plan
3. Alpha Consulting Engineers, Inc. Job 88001, Sheet 1 - Sanitary Sewer - Forcemain
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7. J.A. Lombardo & Associates, Inc. Job 8609, Sheet 3 - Electrical Site Plan
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Specification No. APCML91-5
July 29, 1991

BID DOCUMENTS
HAZARDOUS WASTE DISPOSAL SITE - CELL II
ALLEN PARK CLAY MINE LANDFILL
ALLEN PARK, MICHIGAN

1. BIDDING INSTRUCTIONS

- A. Bidders shall submit their proposals on the Form of Proposal provided, and all required attachments, in duplicate.
- B. The following data shall be furnished by the Bidder, on each page of the Proposal:
 - 1. Name of Bidder
 - 2. Proposal Number
 - 3. Date of Proposal
- C. Each copy of the Proposal shall be signed (including title) by the Bidder.
- D. Bids shall be submitted complete with a lump sum price and breakdown prices as indicated on the Form Of Proposal.
- E. Bidder shall utilize unionized tradesmen in performing the Work described in this Specification.
- F. The Bidder shall include with his Proposal an Equipment And Composite Labor Rate schedule which will be utilized for Work beyond the scope of this Specification and not covered by Contract Unit Prices. All Work considered to be beyond the scope of this Specification must be authorized by Ford prior to the commencement of the Work.
- G. Bidder shall include in his Proposal a complete list of proposed Sub-contractors, indicating what service each will provide. The Purchaser reserves the right to reject any or all of the proposed Sub-contractors prior to award of Contract. The use of minority subcontractors is strongly encouraged for all Work performed at the Allen Park Clay Mine Landfill.
- H. Bidder shall include in his Proposal a schedule indicating the timing and duration of all activities included in Specification APCML91-5. The schedule should indicate a completion date for the installation of the primary clay liner of no later than November 22, 1991. Work shall be suspended at that point and resumed on or about May 4, 1992.
- I. No oral agreements or conversations with any officer, agent or employee of the Ford Motor Company, either before or after the execution of the Contract, shall affect or modify the terms and obligations contained therein.
- J. If there are any items required in addition to those specified, it is intended that they be furnished by the successful Bidder, and such items shall be brought to the attention of the Purchaser by the Bidder in his Proposal.

1. BIDDING INSTRUCTIONS (cont'd)

- K. Should the Bidder find any discrepancies in or omissions from the Specification and/or drawings, or be in doubt as to their meaning, he shall notify the Engineer, who will, if required, send written instructions to all Bidders.
- L. Bidders may visit the site (by appointment with Ford) to become thoroughly familiar with all conditions of the proposed Work.
- M. It is understood and agreed that the Bidder has, by careful examination, fully satisfied himself as to the nature of the Work, the location of the Work, the conformation and character of the ground, the character, quality, and quantity of the materials required, the kind of equipment and facilities needed, the general and local conditions, and all other matters which can, in any way, affect the Work under this Contract both preliminary to and during the prosecution of the Work.
- N. Work under this Specification shall be subject to approval of the Engineer, who shall determine the quality, acceptability, and fitness of each kind of Work and material furnished hereunder and who shall decide all questions which may arise as to the fulfillment of the requirements of this Specification and the order of precedence of the various parts of the Work. His decision shall be final.
- O. Cell II is being constructed as a hazardous waste cell pursuant to Act 641 of the Public Acts of 1978, as amended, of the Michigan Compiled Laws and known as the hazardous waste management act. The requirements of all applicable Federal, State, and Local regulatory codes shall be met and shall govern over any specific requirement of this Specification where a conflict or ambiguity exists unless this Specification is more stringent. It shall be the Contractors responsibility to obtain copies of, and be conversant with, such regulations.
- P. The Purchaser reserves the right to reject any or all bids.

Specification No. APCML91-5
July 29, 1991

2. FORM OF PROPOSAL

Name of Bidder _____

Address of Bidder _____

City, State and Zip Code _____

A. Lump Sum Price

The undersigned proposes to provide all labor, materials, project management, supervision, equipment, and services necessary to complete the Phase I construction of Cell II in accordance with Specification APCML91-5 dated July 29, 1991 for a lump sum price of:

\$ _____

B. Bid Breakdown

1. Mobilization (Sect 3.3)

B.1 Subtotal _____

2. Excavation/Stockpile of Unsuitable Material

B.2 Subtotal _____

3. Secondary Clay Liner Construction (Sect 3.4 & 3.5)

i. Cuts

ii. Fill

B.3 Subtotal _____

4. Artesian Water Collection/Removal System (Sect 3.6)

a. Preparation Of Clay Surface

b. Furnish & Install Sump, Pipe, Aggregate, Geotextile Pipe Wrap & Pump

c. Furnish & Install Geonet/Geotextile (By Others)

B.4 Subtotal _____

Subtotal This Sheet (p. P-3) _____

Bidder _____

Proposal No. _____

Proposal Date _____

2. FORM OF PROPOSAL (cont'd)

Carryover Previous Sheet (p. P-3) _____

5. Secondary FML Installation (Sect 3.7)
a. Install Anchor Trenches
 i. Excavate _____
 ii. Backfill _____
b. Furnish & Install 80 mil FML (By Others) _____
 B.5 Base Bid Subtotal _____
6. Secondary Leachate Collection/Removal System (Sect 3.8)
a. Furnish & Install Geonet/Geotextile (By Others) _____
d. Furnish & Install Collection Pipes, Sumps,
 Aggregate, and Geotextile Pipe Wrap _____
f. Furnish & Install Pumps, Discharge
 Piping, Electrical Controls, Etc. _____
 B.6 Base Bid Subtotal _____
7. Primary Clay Liner Installation (Sect 3.9)
 B.7 Base Bid Subtotal _____
8. Install Primary FML (Sect 3.8)
a. Preparation of Clay Surface _____
b. Install Anchor Trenches
 i. Excavate _____
 ii. Backfill _____
c. Furnish & Install 80 mil FML (By Others) _____
 B.8 Base Bid Subtotal _____
- Subtotal This Sheet (p. P-4) _____

Bidder _____

Proposal No. _____

Proposal Date _____

2. FORM OF PROPOSAL (cont'd)

Carryover Previous Sheet (p. P-4) _____

- | | | |
|--|---|-------|
| 9. Leachate Collection System (Sect 3.10) | | |
| a. Furnish & Install Geonet/Geotextile | (By Others) | _____ |
| b. Install Scuff Strips | | _____ |
| c. Furnish & Install Sand Layer and Geotextile Wrap. | | _____ |
| d. Furnish & Install Collection Pipes, Aggregate, & Geotextile Pipe Wrap | | _____ |
| e. Furnish & Install Manhole | | _____ |
| f. Furnish & Install Pump, Discharge Piping, Sewer, Electrical Controls, Cleanouts, Etc. | | _____ |
| | B.9 Subtotal | _____ |
| 10. Surface Restoration (Sect 3.11) | | |
| | B.10 Subtotal | _____ |
| 11. Site Drainage | | |
| | B.11 Subtotal | _____ |
| 12. Construct Permanent Access Ramp | | |
| | B.12 Subtotal | _____ |
| 13. Site Maintenance | | |
| | B.13 Subtotal | _____ |
| | Bid Breakdown Total - Items B.1 to B.13 | _____ |

Subtotal This Sheet (p. P-5) _____

Bidder _____

Proposal No. _____

Proposal Date _____

Specification No. APCML91-5
July 29, 1991

2. FORM OF PROPOSAL (cont'd)

- C. Preference will be given to Minority Contractor participation. This proposal includes minority involvement as joint venture or sub-contractor as follows:

Minority Participation _____ % \$ _____

Minority Participants: _____ \$ _____
_____ \$ _____

D. Unit Price Schedule

The following Unit Prices shall be submitted by the Contractor and shall be applied to Work that is added or deleted from the Contract. These Unit Prices shall be complete and include all labor, material, supervision, fringe benefits, profit, overhead, taxes, insurance, and Contractor's handling fees. These rates shall be valid for the duration of the construction period.

<u>Item</u>	<u>Unit</u>	<u>Add/Deduct Amount</u>
Gen Excavation & On-Site Stockpile Of Clay.	cy	_____
Gen Excavation & On-Site Stockpile of Unsuitable Fill Material.	cy	_____
Backhoe Excavation And On-site Stockpile Of Clay.	cy	_____
Clay Placement and Compaction To Specification (Clay Removed From On-Site Stockpile Or Excavation)	cy	_____
Clay Placement and Compaction To Specification (Off-Site Clay Supplied By Owner, Delivered To Cell II Site On Truck, And Unloaded At Location Selected By Contractor).	ton	_____

Bidder _____

Proposal No. _____

Proposal Date _____

Specification No. APCML91-5
July 29, 1991

2. FORM OF PROPOSAL (cont'd)

D. Unit Price Schedule

Receive Clay From Outside Supplier & Stockpile On-Site.	ton	_____
Supply & Install Sand To Specification.	ton	_____
Install HDPE Scuff Strip to Specification.	ft ²	_____
Supply & Install Leachate Col- lection Pipe, Stone, and Geotextile Pipe Wrap to Specification.	ft	_____
Supply & Install Artesian Drain Pipe, Aggregate, and Geotextile Pipe Wrap to Specification (Trenching Not Included).	ft	_____
Supply & Install Leachate Collection Manhole Complete To Specifications.	ea	_____
Supply & Install 6 ft Precast Concrete Collection Sump Complete To Specifications.	ea	_____
Supply Leachate Collection Pump Per Specification Complete With Lifting Chain & Power Cable.	ea	_____
Supply Secondary Leachate Collection Pump Per Specification Complete With Lifting Chain & Power Cable.	ea	_____
Supply Artesian Collection Pump Per Specification Complete With Lifting Chain & Power Cable.	ea	_____
Supply Storm Water Dewatering Pump Per Specification	ea	_____

Bidder _____

Proposal No. _____

Proposal Date _____

Specification No. APCML91-5
July 29, 1991

2. FORM OF PROPOSAL (cont'd)

D. Unit Price Schedule

Finish Grading	ft ²	_____
Vegetative Cover Per Specification (Including Topsoil).	ft ²	_____
Supply Topsoil Per Specification.	ton	_____
Supply 8" HDPE Pipe With Fittings (SDR 11)	ft ft	_____ Perf _____ Non-Perf
Supply 6" HDPE Pipe With Fittings (SDR 11)	ft ft	_____ Perf _____ Non-Perf
Supply 4" HDPE Pipe With Fittings (SDR 11)	ft ft	_____ Perf _____ Non-Perf
Supply 18" HDPE Riser Pipe	ft	_____

E. Equipment and Composite Labor Rates

Contractor shall submit with his proposal an Equipment and Composite Labor Rate schedule which shall be applied to work which is added to or deleted from Contract work that is not covered by Contract unit prices. These rates shall be complete and include all applicable profit, overhead, taxes, insurance, and Contractor's handling fees. These rates shall be valid for the duration of the construction period.

F. Subcontractors

Attach list of all proposed Subcontractors to the Proposal. The use of minority subcontractors is strongly encouraged for all work performed at the Allen Park Clay Mine Landfill.

G. Time of Completion

The Contractor proposes to complete all Work described in Specification APCML91-5 dated July 29, 1991 in _____ calendar days from the time Purchaser gives notice to proceed to the Bidder. A schedule of the Contractor's activities shall be submitted with this proposal.

Bidder _____

Proposal No. _____

Proposal Date _____

Specification No. APCML91-5
July 29, 1991

2. FORM OF PROPOSAL (cont'd)

H. Addenda

The Bidder acknowledges the following Addenda covering revisions to the Specifications, and the cost, if any, of such revisions has been included in the price herein being quoted:

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

I. Bids to Remain Firm

This proposal shall remain firm for _____ (_____) calendar days (Saturdays, Sundays and Holidays included) from the date hereof.

Name of Bidder

By _____
Title

Dated the _____ day of _____

Telephone Number: _____

Bidder _____

Proposal No. _____

Proposal Date _____



GENERAL CONDITIONS

FOR LUMP SUM CONSTRUCTION CONTRACTS

PLANT ENGINEERING OFFICE

MANUFACTURING STAFF

FORD MOTOR COMPANY

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PLANT ENGINEERING OFFICE

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TERMINATION BY OWNER (55)

The Owner may terminate this contract at any time, at the Owner's discretion, by the giving of written notice delivered to the Contractor, or sent by registered mail to the Contractor at least five (5) days prior to the effective date of termination specified in such notice. After receipt of notice of termination the Contractor shall terminate all work under the contract on the date specified in such notice and shall (1) terminate all orders and subcontracts chargeable to the performance on this contract, which may be terminated without costs; (2) terminate and settle, subject to approval of Owner, other orders and subcontracts where the cost of settlement will be less than costs which would be incurred were such orders and subcontracts to be completed; and (3) transfer to Owner, in accordance with Owner's directions, all materials, supplies, work in process, facilities, equipment, machinery or tools acquired by the Contractor in connection with the performance hereof and for which the Contractor is reimbursed hereunder, and all plans, drawings, working drawings, sketches, specifications and information for use in connection therewith. The Contractor shall, if directed by the Owner and to the extent stated in the Notice of Termination, do such work as may be necessary to preserve the work in progress and to protect material, plant and equipment on the work or in transit thereto.

Upon termination of this contract in accordance herewith and upon compliance by the Contractor with the provisions of the preceding paragraph, in any case other than for breach of this contract arising from fault of the Contractor, the Owner shall pay the Contractor in discharge of all obligations under this contract without duplication and only for (a) such portion of the work as the Contractor and his Subcontractors shall have completed, plus (b) the cost to the Contractor of materials which have been delivered to the plant site of the Owner up to the effective date of termination, plus (c) the cost to the Contractor of materials to be used in performance of this contract for which bona fide, irrevocable orders have been placed by the Contractor prior to the effective date of termination which have not been terminated and settled hereunder, provided that such materials are delivered to the Owner within a reasonable period after the effective date of termination, plus (d) the cost to the Contractor of terminating and settling orders and subcontracts in accordance with this provision, and plus (e) the cost to the Contractor of complying with the Owner's directions relative to the preservation of the work in progress and the protection of materials, plant and equipment on the work or in transit thereto. The payment to be made for any such completed portion of the work shall be in the proportion that the completed portion of the work bears to the entire work provided for in this Contract. Upon any such termination, "cost to the Contractor" as used herein shall include field and home office expense directly applicable to the Contract and not otherwise reimbursed hereunder; however, the Owner shall be under no obligation to pay the Contractor for anticipated profit on any portion of the work not completed. The Owner shall be under no obligation to compensate the Contractor under the provisions of this section if the contract is terminated because of the Contractor's breach of contract. The sum of all amounts payable under this provision, plus the sum of all amounts previously paid under this contract shall in no event exceed the total contract sum. Such costs and expenses shall be subject to audit by the Owner.



GENERAL CONDITIONS FOR LUMP SUM CONSTRUCTION CONTRACTS

PLANT ENGINEERING OFFICE
MANUFACTURING STAFF **FORD MOTOR COMPANY**

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DEFINITIONS (1)

The Contract Documents consist of the Agreement, the General Conditions, the Drawings and Specifications, and all modifications thereof incorporated in the documents before their execution.

The Owner is Ford Motor Company, a Delaware Corporation having its office at The American Road, Dearborn, Michigan. Except as otherwise specifically provided, all matters pertaining to the work required under this contract will be handled for and on behalf of the Owner by the Director of the Owner's Plant Engineering Office or by such representatives thereof as may from time to time be designated by said Director.

The Resident-Engineer is the representative of the Director of the Owner's Plant Engineering Office or is the Plant Engineer of any Branch Plant to whom the Director has delegated authority in the construction of the work. In addition to those matters elsewhere expressly or by implication delegated to him, the Resident-Engineer shall have the authority:

- (a) in case of emergency or exigency, to require, by written order only, alterations in, additions to, or deductions from the work shown on the drawings or described in the specifications;
- (b) to require minor alterations in the work;
- (c) to interpret the Contract Drawings, Specifications and Bulletins and to resolve all inconsistencies or ambiguities therein;
- (d) to amplify the Contract Drawings, add explanatory information and furnish additional specifications and drawings consistent with the intent of the Contract Documents;
- (e) to determine how the work of this contract shall be coordinated with work of other Contractors engaged simultaneously on this project, including the power to suspend any part of the work, but not the whole thereof; and



GENERAL CONDITIONS

"LUMP SUM CONSTRUCTION CONTRACTS"

PLANT ENGINEERING OFFICE

FORD MOTOR COMPANY

(Continued)

DEFINITIONS (1)

- (f) to take such other steps and to exercise such other or further authority with respect to the Contract as may from time to time be directed by the Director of the Owner's Plant Engineering Office.

Such decisions as the Resident-Engineer may, from time to time, make with respect to questions concerning the interpretation of the drawings and specifications or inconsistencies appearing therein, and as to the quality or fitness of materials, equipment and workmanship, shall be final and binding upon the parties hereto.

The Inspectors are representatives of the Resident-Engineer and shall perform such duties and exercise such authority as may be assigned or delegated to them by the Resident-Engineer.

The Architect or Architect-Engineer, when employed by the Owner to prepare plans and specifications for the work, may, if so authorized by the Owner, assign one or more of his representatives to be present at the site of the work, either on a full-time or part-time basis. Such representative or representatives shall render such assistance as may be requested by the Resident-Engineer and shall perform such other duties as may be by the specifications be delegated to the "Architect-Engineer", "Architect" or "Engineer".

In the event a representative or representatives of the Architect or Architect-Engineer shall not be present at the site of the work, the terms "Architect-Engineer", "Architect", or "Engineer", wherever used in the specifications, shall be deemed to read "Resident-Engineer".

EXAMINATION OF PREMISES (2)

The Contractor shall be held to have examined the premises and site so as to compare them with the drawings and specifications, and to have satisfied himself as to the condition of the premises, any obstruction, the actual levels, and all excavating, filling in, etc., necessary for carrying out the work, before the delivery of his proposal. The Contractor shall also acquaint himself with the character and extent of the Owner's and other Contractor's operations in the area of the work so that he may make his construction plans accordingly. No allowances or extra payment will be made to the Contractor for or on account of costs or expenses occasioned by his failure to comply with the provisions of this paragraph, or by reason of error or oversight on the part of the Contractor, or on account of interferences by the Owner's or other Contractor's activities.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

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SURVEYS (3)

The Owner will establish the lot lines and permanent bench mark. All other lines and levels necessary to the location and construction of the work under the contract shall be established and maintained by a competent surveyor who shall be employed and paid by the Contractor. The Contractor shall compare carefully all levels given on drawings with existing levels and shall call the Owner's attention to discrepancies before proceeding with the work.

LAWS, ORDINANCES AND REGULATIONS (4)

The Contractor shall, in the performance of the contract, comply with, and give all stipulations and representations required by, all applicable Federal, State and Local Laws, Ordinances and Regulations, and shall require such compliance, stipulations and representations by all other persons with whom he shall enter into any contract pertaining to the work hereunder. Any deviations from the plans or specifications and any additional work necessary to meet code requirements shall be made by the Contractor without extra cost to the Owner. The Contractor shall be liable for and indemnify and hold harmless the Owner from any and all liability or damage arising by reason of the breach of the provisions herein set forth.

The design, materials and construction of this work shall also conform to the following standards:

American Society for Testing Materials
American Standards Association
American Railroad Engineering Association
National Electric Code
National Board of Fire Underwriters
Factory Insurance Association, Fire Prevention
Engineering Consultants
Ford J.I.C. Electrical Specifications

BUILDING PERMITS (5)

Plans and specifications for the building will be filed and general permit will be obtained by the Owner. All other permits shall be obtained and, with all inspection fees, shall be paid for, by the Contractor for the respective work requiring such permits.



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GENERAL CONDITIONS

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TAXES (6)

The Contractor shall include in his proposal and shall pay all applicable Federal, State and Local Taxes of whatever character and description.

TAXES - ASSIGNED ORDERS OR CONTRACTS (7)

The Owner shall with respect to such assigned fixed price purchase orders or contracts as contain a statement to the effect that the property described therein is exempt from sales and/or use tax (in lieu of a provision for the payment thereof), reimburse the Contractor in full for the amount of such sales and/or use tax, including interest and penalty, as said Contractor is thereafter legally required to and does pay; PROVIDED, that the Contractor shall (a) take all necessary steps to protect its and the Owner's rights in the premises, and (b) initiate timely conferences with representatives of Owner's Office of Tax Affairs and defend against or pay the tax, interest and penalty asserted by a taxing body to be due as the Owner may direct; PROVIDED FURTHER, that the Owner shall reimburse the Contractor for such expense as may reasonably be incurred by the latter in complying with the Owner's directions.

ALTERNATE, SEPARATE AND UNIT PRICES (8)

The Contractor shall carefully read the proposal sheet and submit prices for all alternates, unit prices and separate prices that may be required.

Unit Prices shall be the same for both additions and deductions; shall include all overhead and profit; and shall be net to the Owner for work in place. Unit Prices shall include all incidental items such as hoisting, cleaning, painting, cleaning up debris, etc., the intention being to leave the respective items finished and debris cleaned up in the manner required for similar work under the original Specifications and General Conditions.

ACCEPTANCE AND REJECTION OF PROPOSALS (9)

The Owner reserves the right to accept any proposal or reject any and all proposals or part of any proposal.



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~ LUMP SUM CONSTRUCTION CONTRACTS

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SPECIFICATIONS (10)

While the specifications may be sub-divided into trades (for the sole purpose of facilitating the work), the Contractor shall be held to furnish all labor and materials necessary to provide a complete piece of work as contemplated by the plans and the specifications, and he shall be responsible for the same as called for under the various clauses therein. Any item mentioned under any heading must be supplied even though it be not called for again under the heading for the particular trade. The Contractor shall also do any required cutting and altering of, and fitting to, his work, partially or entirely completed, to make possible other work, including that of trades not part of the contract, as indicated on the drawings even though not specifically covered under sub-headings.

SPECIFICATIONS AND DRAWINGS TO BE CO-OPERATIVE (11)

The Specifications and the accompanying drawings are intended to describe and provide for a finished piece of work. They are intended to be co-operative, and what is called for by either shall be as binding as if called for by both.

It is understood and agreed by the Contractor that the work therein described shall be complete in every detail, even though every item necessarily involved is not particularly mentioned. The Contractor shall provide all labor and materials necessary for the entire completion of the work intended to be described, and shall not avail himself of any manifestly unintentional error or omission should such exist.

All requirements called for by the Drawings or Specifications shall be binding upon the Contractor. In case of error or inconsistency, the provisions of the Specifications shall take precedence over the Drawings. Where Special Provisions and Standard Specifications are included in the contract the Special Provisions shall take precedence over plans and Standard Specifications where inconsistency exists between the latter items. The figured dimensions on Drawings shall govern in case of inconsistency between the scales and figures. The Contractor shall take no advantage of, and shall promptly call the Owner's attention to, any error, omission or inconsistency in the Specifications and Drawings. The Resident-Engineer shall make such corrections and interpretations as may be deemed necessary for the completion of the work in a satisfactory manner.

All enrichments, mouldings, etc., indicated on the drawings or details, or drawn in part only, for any particular area or location, shall be deemed to continue throughout like areas or locations, unless distinctly shown or noted otherwise. Similarly with respect to other parts of the work, for which only a portion is completely drawn or detailed, all like work shall conform to the portion so drawn or detailed, and shall be deemed to continue throughout like areas or locations, unless distinctly shown or noted otherwise.

Full sized details furnished the Contractor after award of the contract are intended to correspond with scale drawings. Where differences involving additional work exist, the Contractor shall immediately call the Owner's attention thereto and shall not commence the work covered by such detail except upon written order from the Owner. No extra charge will be allowed unless so ordered by the Owner.





GENERAL CONDITIONS

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SIGNED PLANS AND SPECIFICATIONS (12)

Immediately upon the award of the contract for the performance of the work, the Contractor and a representative of the Owner's Purchasing Office shall sign as many sets of Plans and Specifications, including all modifications thereof, as may be required by the Owner. One (1) set will be returned to the Contractor. One (1) set will be filed with the Architect-Engineer when employed by the Owner.

NUMBER OF WORKING DRAWINGS AND SPECIFICATIONS (13)

The Owner will furnish to the Contractor not more than ten (10) sets of blueprints on paper, and not more than six (6) sets of specifications, for construction and for each bulletin. The Contractor may procure additional copies of blueprints and specifications for construction and bulletins at cost of reproduction. Such costs are not reimbursable by the Owner.

ASSIGNMENT AND SUBLETTING OF CONTRACT (14)

The Contractor shall not assign or sublet the whole or any part of the work without the written consent of the Owner and without the written approval by the Owner of the specific party to whom it is proposed to assign or sublet the same. No such consent and approval, and no approval of the form of such assignment or subletting, shall release or relieve the Contractor from any of the obligations and liabilities assumed by him under this contract, and, as between the parties hereto, the Contractor shall remain responsible and liable as if no such assignment or subletting had been made.

REVIEW OF CONTRACTOR'S DRAWINGS (15)

The Contractor shall submit drawings for review in sufficient time to prevent delays in the delivery of materials. Such drawings shall be submitted in the order in which materials are needed at the site and without necessarily waiting for the completion of all drawings before submitting part of them to the Owner or Architect-Engineer.

The Contractor will be required to obtain approval of the shop drawings for Fire Prevention and Automatic Sprinkler Work from the Factory Insurance Association and the State Rating Bureau having jurisdiction, prior to sending such drawings to the Owner or Architect-Engineer for approval.

All Subcontractor's drawings shall be sent direct to the Contractor, who shall keep a record of the dates of receipt and drawing numbers thereof. The Contractor shall carefully check the measurements, sizes of members, materials and all other details shown by such drawings, in order to assure himself that they conform to the intent of the plans and specifications, and shall promptly return to the Subcontractors for correction such of the drawings as are found inaccurate or otherwise in error. After the Contractor has checked and approved the Subcontractor's drawings, he shall place thereon the date of such approval and the signature of the checker and then submit them to the Owner.



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REVIEW OF CONTRACTOR'S DRAWINGS (15) (Cont'd.)

When drawings are to be forwarded to the Owner, the Contractor shall, unless otherwise directed, submit not less than three (3) copies of all Contractor's and four (4) copies of all Subcontractor's drawings to the Owner for review. The Owner will, after reviewing the drawings submitted to him, retain two (2) copies of each drawing and return the remaining copies to the Contractor.

When an Architect-Engineer has been employed by the Owner to prepare plans and specifications, the Contractor shall submit not less than five (5) copies of all Contractor's and six (6) copies of all Subcontractor's drawings, to the Architect-Engineer instead of to the Owner. The Architect-Engineer and the Owner will retain four copies and return the remaining copies to the Contractor.

Neither the receipt nor the review of such drawings by the Owner or Architect-Engineer shall relieve the Contractor from errors or omissions which may occur, even though the work is done in accordance with such drawings. Where such errors or omissions are discovered later, they shall be made good by the Contractor, irrespective of the receipt and review of the drawings by the Owner or Architect-Engineer.

Should the Owner so require, the Contractor shall, upon completion of the work, furnish to the Owner a complete set of reproductions, neatly bound together, of all Contractor's and Subcontractor's drawings. The Owner will reimburse the Contractor the actual cost of reproduction.

OWNER'S OPTIONS (16)

In all cases where the choice of more than one make or type of article or material is specified, or where the Specifications call for a stipulated item "or other equal thereto and approved", or other words to that effect, the final selection of the make or type rests with the Owner. Where any difference occurs in price, such difference shall be stated before the contract is awarded. After the contract has been awarded, the Owner reserves the right to choose whichever make or type he desires, and, unless previously advised to the contrary, there shall be no change in the contract sum by reason of the exercise of such right.

The Owner reserves the right to let, independent of the contract for work herein specified, any other work on the premises even if of like character and trades.

APPROVAL OF EQUIPMENT AND MATERIAL MANUFACTURERS (17)

Before placing orders therefor, the Contractor shall submit to the Owner's Plant Engineering Office for approval, a list of the manufacturers from whom the Contractor proposes to purchase materials and equipment. The Contractor and his Subcontractors shall, on request, promptly furnish to the Resident-Engineer unpriced copies of orders pertaining to such materials and equipment, and all available information relative to the projected dates of delivery thereof.





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SAMPLES TO BE SUBMITTED (18)

The Contractor shall furnish to the Resident-Engineer for approval, when requested or required by the Specifications, samples of all materials and finishes to be used in the execution of the work. Such samples shall be submitted before the work is commenced and in ample time to permit examination thereof. All materials furnished and finishes applied shall be fully equal to the approved samples.

TESTS (19)

When required in writing by the Resident-Engineer, the Contractor shall make such tests as may be necessary to show that the requirements of the specifications have been fulfilled.

All tests shall be made under the supervision and direction of the Resident-Engineer, and the Contractor shall provide all required materials, labor and apparatus, etc., or shall, if so directed, engage an approved testing laboratory for making same.

Any work found defective shall be removed, replaced and retested until satisfactory to the Resident-Engineer, all at the Contractor's expense.

Should tests required by the Resident-Engineer, except those specifically called for elsewhere in these General Conditions or in the Specifications, show that the requirements of the specifications have been fulfilled, then the costs of such tests shall be paid for by the Owner.

MEASUREMENT AND FITTING OF PARTS (20)

The Contractor, without extra charge, shall make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. The Contractor shall verify all dimensions given in the drawings, and shall report any error or inconsistency to the Owner before commencing the work.

INSPECTION OF WORK AWAY FROM PREMISES (21)

When any portion of the work is to be executed away from the premises, the Contractor shall notify the Resident-Engineer in reasonable time, where such work is to be done and when it will be ready for inspection, in order that same may be inspected from time to time before delivery thereof to the Plant Site.

QUALITY OF MATERIALS AND WORKMANSHIP (22)

All work done and materials furnished shall be first-class in every respect and, unless otherwise specified, all materials and equipment shall be new and of the latest design.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

PLANT ENGINEERING OFFICE

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DELIVERY OF MATERIALS (23)

The Contractor shall pay all demurrage that may accrue on all cars of material or equipment furnished by him in connection with the work.

The Contractor shall be responsible for the unloading, checking and storing of all materials owned or used by him in connection with the work.

The Contractor shall cause all materials which he purchases for use on the work to be consigned directly to the Contractor as Consignee, and shall handle all matters pertaining to freight charges and charges for demurrage directly with the carriers involved.

REMOVAL OF UNFIT MATERIALS (24)

The Contractor shall, upon notification by the Resident-Engineer, immediately remove and replace, to the satisfaction of the Resident-Engineer, all materials and work of unsound or unfit character.

The expense of removing, reconstructing, replacing or refinishing unsound or unfit materials and work, the cost of making good other work affected thereby and the cost of delays resulting therefrom, shall be borne by the Contractor and no extension of time will be allowed for such correcting of faulty materials or work.

MOVING MATERIALS (25)

If it becomes necessary, at any time during the performance of the work, to move materials which are to enter into the construction, or equipment which has been temporarily placed, the Contractor responsible for said materials or equipment, when so directed by the Resident-Engineer, shall move or cause the same to be moved without additional charge.

ACCIDENT PREVENTION (26)

The Contractor shall comply with the "Safety and Engineering Practices" as set forth in the "Manual of Accident Prevention in Construction" as published by the Associated General Contractors of America, and with all applicable State and Local Safety and Sanitary Laws, Regulations and Ordinances, as well as the established safety rules and practices of the Owner.

The Contractor shall properly protect Owner's and adjoining property from injury. Any damage to same shall be made good without delay. Particular care shall be exercised to protect all trees which are to remain, including the roots of same.

The Contractor shall provide and properly maintain warning signs and lights, barricades, railings and other safeguards for the protection of workmen and others on, about or adjacent to the work, as required by the conditions and progress of the work.



GENERAL CONDITIONS

~ LUMP SUM CONSTRUCTION CONTRACTS

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EXPLOSIVES (27)

The Contractor shall obtain the permission of the Resident-Engineer before using dynamite or other explosives on the property of the Owner and shall be governed by the established safety rules and practices of the Owner in their use and storage.

FIRE PRECAUTIONS AND PROTECTION (28)

a. The General Contractor and Subcontractors shall take all necessary precautions to guard against and eliminate all possible fire hazards and to prevent damage to any construction work, building materials, equipment, temporary field offices, storage sheds, and all other property, both public and private.

b. The General Contractor's Superintendent in charge of the project, together with the Resident-Engineer, shall inspect the entire project at least once each week to make certain that the Conditions and requirements set forth below are being adhered to.

c. The General Contractor shall be responsible for providing, maintaining and enforcing the following conditions and requirements during the entire construction period:

1. Water Supply, Fire Hose and Sprinkler Protection: The fire service underground mains, yard hydrants and connection to water supply shall be installed as soon as construction begins so that ample water is immediately available for fire fighting purposes.

An adequate supply of hose to protect the construction area shall be provided as soon as water is available. Amount of hose required shall be subject to approval of the Resident-Engineer. Hose shall be 2½" approved cotton rubber lined fire hose in hose cabinets or carts and equipped with combination water spray and solid stream nozzles.

Automatic sprinkler systems and inside standpipes and hose shall be placed in service as construction proceeds. As each sprinkler system is completed and placed in service, the control valves shall be sealed. Permission to break the seals and close sprinkler valves shall be given only by the Resident-Engineer.

2. Fire Extinguishers: Provide and maintain in working order at all times, during construction, not less than four (4) fire extinguishers conveniently located for proper protection, for each building having 5000 sq. ft. of total floor area or less. One (1) additional fire extinguisher shall be provided for each additional 5000 sq. ft. of floor area.

Fire extinguishers shall be either a 2½ gallon capacity water type gas cartridge expelled unit or 5 gallon capacity pump type protected from freezing by use of calcium chloride, all to meet approval of Fire Underwriters' Laboratory, and shall be inspected at regular intervals and recharged if necessary.



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FIRE PRECAUTIONS AND PROTECTION (28) (Cont'd.)

In areas of flammable liquids, asphalt, or electrical hazards, extinguishers of the 15 lb. carbon dioxide type or 20 lb. dry chemical type shall be provided.

3. Personnel:

- (a) At least one qualified person, as determined by the Resident-Engineer, thoroughly familiar with fire protection and prevention shall be on duty at all hours that Contractor's employees are working to patrol premises with authority to take immediate remedial action to eliminate unnecessary fire hazards.
- (b) Guards shall be on duty during all hours that building tradesmen are not working. These men shall patrol the entire premises, including yard area, temporary contractor's offices and storage buildings at least once an hour. Recording watchmen's clocks shall be used at the discretion of the Resident-Engineer. Persons selected for guard service shall be mature, have good judgment, be reliable and trustworthy, and be physically, mentally and morally responsible. Intemperate, physically unfit and otherwise undesirable persons shall not be entrusted with the responsibility of guard patrol.
- (c) Guards will be instructed by the Resident-Engineer who will outline specific procedures and steps to be taken during an emergency.
- (d) The Contractor shall agree that in the event of a fire all his workmen and those of Subcontractors' workmen anywhere on the site will assist in extinguishing the fire.
- (e) Employees shall not be allowed to start fires with gasoline or kerosene or other highly flammable materials. No open fires will be permitted.
- (f) No welding, flame cutting or other operations involving the use of flame, arcs or sparking devices, will be allowed without adequate protection and prior permission of the Owner's Resident-Engineer. All combustible or flammable material shall be removed from the immediate working area. If removal is impossible, all flammable or combustible materials shall be protected with an asbestos fire blanket or suitable noncombustible shields to prevent spark, flames, or hot metal from reaching the flammable or combustible materials. The Contractor shall provide the necessary personnel and fire fighting equipment to effectively control incipient fires resulting from welding or flame cutting, or other operations involving the use of flame, arcs or sparking devices.

4. Flammable Materials: Not more than one day's supply of flammable liquids such as oil, gasoline, paint or paint solvent shall be brought into the building at any one time. All flammable liquids having a flash point of 110° F. or below which must be brought into the building shall be confined to Underwriters' Laboratories labelled safety cans. The bulk supply of all flammable liquids shall be detached at least 75 feet from the building and from yard storage of building materials. Spigots on drums containing flammable liquids are prohibited on the project site. Drums are to be equipped with approved vented pumps.



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FIRE PRECAUTIONS AND PROTECTION (28) (Cont'd.)

Only a reasonable working supply of flammable building material shall be located inside of, or on the roof of the building.

All tarpaulins used during the course of construction shall be of a flameproof type secured in place against damage or "flapping" from winds.

All oil soaked rags, papers, and other combustible materials shall be removed from the building at the close of each days work or more often if necessary and placed in metal containers with self closing lids.

No gasoline, benzine or like combustible materials shall be poured into sewers, manholes, or traps, but shall be disposed of, together with all flammable or waste material subject to spontaneous combustion, in a manner approved by the Resident-Engineer. The Contractor shall obtain permission from the Resident-Engineer before bringing any of the foregoing materials to the site, and shall make appropriate arrangements for storing same.

5. Temporary Heating Facilities: Temporary heating facilities shall be inspected regularly to assure that they are in safe operating condition at all times. No liquid fuel shall be used for starting a solid fuel fire. Wood or other debris shall not be burned in coke fired salamanders. Oil fired stoves shall be approved by Underwriters' Laboratories and have safety combustion controls and integral fuel tanks not to exceed 15 gallons capacity for each stove.

Heating devices shall be approved by the Resident-Engineer prior to placing them in service.

6. Contractors' Shanties, Sheds, and Equipment: Contractors' shanties of combustible construction shall not be placed inside of the structure. Such shanties shall be detached at least 75 feet from the building. Totally incombustible shanties may if necessary be located inside of the structure.

Heaters and/or stoves in field offices or storage sheds shall have fire resisting material underneath, and at sides near partitions and walls. Pipe sleeves and asbestos coverings shall be used where stove pipe runs through wall or roof.

Flammable portions of construction shanties must be painted outside with a Ford Motor Company approved fire retardant paint.

7. General Precautions and Rules:

- (a) Automobiles shall not be allowed to park within the perimeter of any building under construction or completed. Trucks and other motor vehicles used in connection with the construction of the project shall not be parked within any building at any time except when construction is in progress and the operator responsible for the vehicle is present.



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FIRE PRECAUTIONS AND PROTECTION (28) (Cont'd.)

- (b) Materials and/or equipment stored in cardboard cartons, wood crates or other combustible containers shall be stored in an orderly manner and accessibly located. Fire fighting equipment of approved types shall be placed in the immediate vicinity of any materials or equipment stored in this type of crate or carton until permanent fire protection equipment is available.
- (c) All roofing materials, roof insulation, etc., shall be stored outside of all buildings, and properly protected. No tar kettles will be allowed within any building. No more than one day's supply of other unpackaged combustible building materials shall be stock-piled within the building at any time.
- (d) Location of nearest public fire alarm box and phone number of local fire department shall be conspicuously posted throughout the field offices and building structure.

LIABILITY INSURANCE (29)

The Contractor shall procure and maintain in such companies as are acceptable to Owner, and before starting work shall provide Owner with Certificates of Insurance covering the following risks:

- (a) Workmen's Compensation and Employers' Liability Insurance.
- (b) Public Liability and Property Damage Liability Insurance, including Contractual Liability and Property Damage, with limits of not less than
 - \$200/500,000 for bodily injury
 - \$100,000 for property damage
- (c) Automobile Liability Insurance, including all owned, non-owned or hired vehicles, with limits of not less than
 - \$200/500,000 for bodily injury
 - \$100,000 for property damage

The furnishing of the foregoing Certificates of Insurance shall not operate to relieve the Contractor from any liability or obligation for which he would otherwise be responsible under this contract.

OWNER'S AND CONTRACTOR'S RESPONSIBILITIES (30) - FIRE AND CERTAIN OTHER RISKS

- (a) The Owner shall assume the risk of loss of or damage to all work performed and materials delivered to the site of the work, whether or not installed (except as otherwise provided in paragraph (b) hereof), caused by fire, extended coverage perils, vandalism and malicious mischief, and the Contractor shall in no event be liable for any such loss or damage.



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GENERAL CONDITIONS

" LUMP SUM CONSTRUCTION CONTRACTS

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OWNER'S AND CONTRACTOR'S RESPONSIBILITIES (30) FIRE AND CERTAIN OTHER RISKS (Cont'd.)

(b) The Contractor shall assume the risk of loss of or damage to its construction machinery, tools and/or equipment, shanties and/or field offices (and contents thereof) supplied by Contractor, and employees' tools and effects and the Owner shall in no event be liable for any such loss of or damage to such property, nor shall the Owner be liable for any such loss of or damage to any property of subcontractors.

CONTRACTOR'S RESPONSIBILITY FOR PERSONAL INJURIES AND PROPERTY DAMAGE (31)

The Contractor shall be exclusively responsible for, shall bear, and shall relieve the Owner from liability for all loss and/or expense and/or damage and/or claims resulting from bodily injury, sickness or disease, including death at any time resulting therefrom, sustained by any person or persons, and/or on account of damage to or destruction of property, including that of the Owner, and/or on account of loss of use of such property (except as otherwise specifically provided in the section hereof entitled 'Owner's and Contractor's Responsibilities - Fire and Certain Other Risks'), arising out of, or in connection with the performance of any work called for by this Contract, including all work assigned to the Contractor under this Contract, whether such loss, expense, damage and/or claims be caused by or result, in whole or in part, from the negligence or other conduct of the Contractor, any Subcontractor and/or the Owner, or any of the employees, agents or servants of any of them, or any other person or persons whatsoever, except that, anything to the contrary notwithstanding contained herein, the Contractor shall neither be responsible nor relieve the Owner from liability for the willful misconduct or the sole negligence of the Owner or any of its employees, agents or servants.

CONTRACTOR'S RESPONSIBILITY - OTHER RISKS (32)

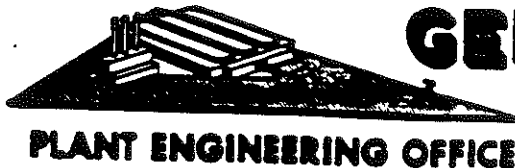
The Contractor assumes all risks, hazards and conditions which may be encountered in the performance of the work, such as, but not limited to, bad weather, delays in delivery of material and equipment, strikes and labor disturbances (whether directed against the Owner, the Contractor and/or other Contractors) and embargoes, and no extra payment or charge will be allowed on account thereof. The Owner shall likewise not be held responsible for any damage, loss or expense incurred by the Contractor through the fault of any other Contractor employed by the Owner.

PROGRESS SCHEDULE AND TIME OF COMPLETION (33)

The work shall be carried to completion with utmost speed.

Immediately upon award of the contract, the Contractor shall prepare and submit a definite progress schedule and furnish same to the Owner for approval. The Contractor shall execute all portions of the work in accordance with the approved schedule.

If necessary, in order to complete the work within the time stated in the contract, or if, in the opinion of the Owner, it becomes necessary, in order to maintain the progress schedule, for the Contractor to work after regular hours, the Contractor shall, immediately upon request, work such overtime, additional shifts, Sundays, or holidays, as may be required, without additional cost to the Owner.



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CONTRACTOR RESPONSIBLE FOR COORDINATION (34) AND QUALITY OF WORK

It is not incumbent upon the Owner, the Resident-Engineer and/or the Architect-Engineer to notify the Contractor when to begin, to cease or resume work on individual operations nor to give early notice of the rejection of faulty work, nor in any way to superintend so as to relieve the Contractor of responsibility or of any consequence of neglect or carelessness by him or his Subcontractors. All materials and labor shall be furnished at such time as shall be for the best interest of all Contractors concerned, to the end that all work shall be properly coordinated and completed in accordance with applicable schedules.

Any employee of the Contractor or of his Subcontractors whom the Owner considers detrimental to the proper carrying out of the work shall be removed promptly upon request of the Owner.

PRIORITY OF ITEMS OF WORK (35)

The Contractor shall consult with the Resident-Engineer as to the priority of items of work so as not to interfere with the Owner's operations, as well as to the available space for storage of materials and location of plant, places of access to the work, etc., and all shall be arranged to suit the Owner's requirements. Materials and equipment must be placed to avoid interference with the work of others or the Owner, and shall be removed at Contractor's expense when so required.

DELAYS AND EXTENSIONS OF TIME (36)

Should the progress or completion of the several portions or the whole of the work be delayed as the result of fire, lightning or other casualty for which the Contractor is not responsible, or should the Contractor be delayed in the prosecution of the work through the fault of any other Contractor employed by the Owner, the time of completion of such portion or portions of the work directly affected by such delay shall, unless the Owner elects to terminate the Contract as provided under the heading "Termination by Owner", be extended for a period equivalent to the time lost, which period shall be determined by the Owner. No such extension shall be granted unless the Contractor, within forty-eight hours of the occurrence of the cause of such delay, notifies the Owner, in writing, that such cause has occurred and makes written application for the specific extension of time claimed to be necessitated by reason of such cause.

The Contractor shall have no claim against the Owner for damage, loss, or other expense occasioned by such delays.

ACCELERATION OF WORK (37)

If, in the judgment of the Owner, it becomes necessary at any time to accelerate the work, the Contractor, when ordered and directed so to do, shall without cost to the Owner cease work at any particular point and transfer his men to such point or points, and execute such portion of his work as may be required to enable others to hasten and properly engage and carry on their work.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

PLANT ENGINEERING OFFICE

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CONTRACTOR'S SUPERINTENDENT (38)

The Contractor shall keep a competent Superintendent and any necessary assistants at the site throughout the progress of the work. All directions given to said Superintendent shall be as binding as if given to the Contractor. Upon request, such directions will be confirmed, in writing, to the Contractor.

The Contractor's Superintendent and/or any of his assistants shall be promptly replaced in the event he or they shall prove to be incompetent and/or unsatisfactory to the Resident-Engineer.

ASSISTANCE BY RESIDENT-ENGINEER OR ARCHITECT-ENGINEER (39)

It is distinctly understood and agreed that such assistance as the Resident-Engineer and/or the Architect-Engineer may render to the Contractor in connection with the interpretation of plans and specifications shall not relieve the Contractor from any responsibility for the work. Any work which proves faulty shall be made right by the Contractor without delay.

The failure of the Resident-Engineer, his Inspectors and/or the Architect-Engineer to call the Contractor's attention to faulty work or work done which is not in accordance with plans and specifications shall not prevent the Owner from insisting that the Contractor make all work right.

CO-OPERATION (40)

Anything necessary on the part of any trade to make possible the work of other trades shall be done as part of the contract without additional expense to the Owner.

If the Contractor furnishes material or equipment to be installed by another Contractor, he shall, unless otherwise directed, deliver such material or equipment to the warehouse or storeroom of the Contractor who is to install same. All such material or equipment shall be properly marked to indicate its intended location and use.

CONTRACTOR TO ASSIST OWNER (41)

The Contractor shall render all necessary assistance to the Owner, and, if required, shall take and furnish the Owner with levels, measurements, etc., on the work or grounds as the case may be. The Contractor shall provide sufficient, safe and proper facilities at all times for the inspection of the work by the Owner.

CONTRACTOR'S MEETINGS (42)

At such times as the Resident-Engineer may direct, the Contractor and/or his Subcontractors shall meet with the Resident-Engineer and other Contractors to discuss the status of the work and measures to be taken to further the progress thereof.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

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CONTRACTOR'S MEETINGS (42) (Cont'd.)

All Contractors shall furnish to the Resident-Engineer, immediately upon his request, all available information concerning the conditions and progress of their work.

Representatives who fail to attend such meetings or to execute instructions given them shall on request of the Owner, be dismissed from the work and other representatives shall be immediately substituted.

INSTALLATION OF OWNER'S EQUIPMENT AND MACHINES (43)

The Contractor shall permit the Owner to place and install as much equipment and machinery during the progress of the work as is possible before the completion of the various parts of the work, and agrees that such placing and installation of equipment shall not in any way evidence the completion of the work or any portion of it, nor signify the Owner's acceptance of the work or any portion thereof.

ALTERATIONS AND ADDITIONS (44)

The Owner may, at any time during the progress of the work, without in any way rendering void the contract, order alterations in, additions to or deductions from the work, and, when so ordered in writing, the Contractor shall proceed with the changes directed in such order.

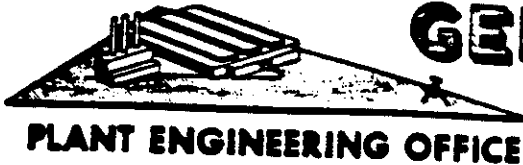
The value of the work altered, added or omitted shall, if unit prices therefor are stated in the contract, be computed in accordance with Method No. 1 hereinbelow set forth. In the event unit prices therefor are not stated in the contract, the value of the work altered, added or omitted shall be computed in accordance with Method No. 2 or Method No. 3, hereinbelow set forth, as directed by the Owner.

METHOD NO. 1 - CONTRACT UNIT PRICES:

Unit prices, if stated in the contract, shall govern not only for alterations in, additions to and deductions from the work in connection with the buildings, structures or installations covered by the plans and specifications, but also for other work located on the premises, incidental or necessary to the use of said buildings, structures or installations, for which plans and specifications may be later prepared.

METHOD NO. 2 - UNIT PRICE OR LUMP SUM PROPOSALS:

Unit prices, if not stated in the contract, and Lump Sum Proposals shall be determined in accordance with a fair and reasonable valuation, made by the Contractor and approved by the Owner. Computations shall be itemized in detail to permit check by the Owner, and all information required by the Owner to establish a fair valuation of the work shall be promptly submitted by the Contractor.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

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ALTERATIONS AND ADDITIONS (44) (Cont'd.)

Should the Owner direct the Contractor to proceed with alterations or additions to the work pending the submission of a price computed in accordance with Method No. 2, the Contractor shall proceed with such alterations or additions on a Force Account Basis, as provided in Method No. 3 following. Should the Unit Price or Lump Sum Proposal, when submitted, not be acceptable to the Owner, then, except as otherwise directed by the Owner, the Contractor shall continue and complete such alterations or additions on a Force Account basis.

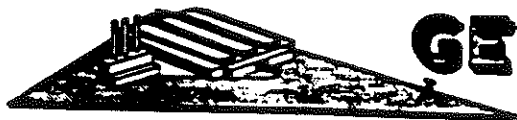
METHOD NO. 3 - FORCE ACCOUNT:

The sums to be paid by the Owner to the Contractor for alterations or additions performed on a Force Account basis shall be:

- (a) The actual cost of all direct labor performed (including foremen employed continuously on the work, but not the salary, or any part thereof, of the Contractor's Superintendent) and all materials furnished for and used in such work, less all available cash, trade and other discounts.
- (b) Rental for the use of such items of equipment as have an individual value in excess of Three Hundred Dollars (\$300.00), provided that the amount of such rental charge and the use of such equipment shall have been authorized in writing by the Owner.
- (c) All sums paid for royalties, permits and inspection fees.
- (d) All premiums for Public Liability Insurance, Workmen's Compensation, and other proper and necessary insurance, as well as all applicable payroll taxes.
- (e) A fee of Fifteen (15%) Per Cent, which fee shall be applied to the total of Items (a), (b) and (c) only and shall constitute full compensation to the Contractor for all costs and expenses not hereinbefore enumerated and all charges for overhead and profit. (Explanatory Note: Subcontractors will receive such part of the aforesaid percentage fee only as may be allotted and paid to them by the Contractor.)

The Contractor shall keep and present, in such manner as the Owner may direct, an accurate account of all of the foregoing costs, together with all supporting vouchers, and said account shall be subject to audit by the Owner.

No claim by the Contractor for increased compensation for alterations or additions (except when done in pursuance of written authorization from the Owner) will be considered unless written notice of claim is made to the Owner before commencement of such work. Drawings without a written order shall not constitute such authority.



GENERAL CONDITIONS

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PATENTS (45)

The Contractor shall pay all royalties and license fees necessary for the full and free use and enjoyment by the Owner of any and all rights to any inventions, machines, processes or devices which may be applied or incorporated as part of the work, either in the construction or use after completion. The Contractor shall at his sole cost and expense defend all suits or claims for infringements of any patent rights and shall forever save the Owner harmless from damage or loss on account thereof.

PERFORMANCE BOND (46)

If requested by the Owner, the Contractor shall furnish a surety company bond, in form satisfactory to the Owner, conditioned upon the faithful performance of the contract and the payment of all obligations arising thereunder. The premium charge for such bond shall be paid by the Owner.

LIENS (47)

The Contractor on his own behalf and (insofar as he is able to contract in that particular) on behalf of all of his Subcontractors and suppliers of material and labor hereby expressly waives the benefits of the Mechanics Lien Laws of the State in which the structure, being constructed, erected or repaired, is located. The Contractor hereby agrees to procure from each and every one of his Subcontractors and suppliers of material or labor a release of any claim to a mechanics lien which they or any of them may have under the Mechanics Lien Laws of the State in which the structure, being constructed, erected or repaired, is located, and in addition agrees to furnish the Owner with each and every other document, affidavit or assurance which, in the opinion of the Owner, is necessary or appropriate to insure the Owner immunity from mechanics liens on account of anything done by the Contractor, or those acting under him or as his Subcontractors in carrying out the terms of this contract and any and all work orders for additions thereto, all as a condition of payments by the Owner on account of this contract, or on account of any of said work orders for additions thereto. Payments made by the Owner without requiring strict compliance with the terms of this paragraph shall not be construed as a waiver by the Owner of the right to insist upon such compliance as a condition of later payments.

If at any time there shall be evidence of the existence, whether or not same has been asserted, of any lien or claim arising out of or in connection with the performance or default in performance of the contract for which the Owner or representatives of the Owner or any property of either or any property installed on the premises might be or become liable, then the Owner shall have the right to retain out of any payment then due or thereafter to become due, in addition to the amounts set forth in the contract, an amount sufficient to discharge such lien or satisfy such claim and to reimburse the Owner and/or the representatives of the Owner for all costs and expenses in connection therewith, including reasonable attorney fees; and the Owner, at its sole discretion, shall have the right to so apply any amounts so retained if the Contractor does not have said lien or claim discharged or satisfied within the ten (10) days after notice.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

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LIENS (47) (Cont'd.)

Neither the final payment nor any part of the retained percentage shall become due until the Contractor shall deliver to the Owner a complete release of all liens arising out of the Contract, or receipts in full in lieu thereof, and an affidavit that, so far as he has knowledge or information, the releases and receipts cover all the labor and materials for which a lien could be filed. The Contractor shall, if any Subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Owner to indemnify it against any and all liens or claims which may at any time be filed or asserted by such Subcontractor.

If the amounts retained by the Owner are insufficient for the afore-said purposes, or if any such lien or claim remains undischarged or unsatisfied after all payments have been made to the Contractor, then the Contractor shall promptly refund to the Owner all moneys that may have been paid to discharge such lien or satisfy such claim, including all costs and expenses and reasonable attorneys' fees in connection therewith.

SCHEDULE OF PRICES AND ALLOCATION OF OWNER'S COST (48)

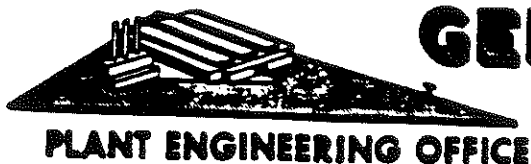
Previous to the first payment under the contract, the Contractor shall submit to the Owner a schedule of prices of the several divisions and sub-divisions of work entering into the contract, to be used as the basis for payments. Said schedule shall be in such detail as the Owner may require in order to enable it to allocate the various items of cost to individual buildings and other structures and installations. The prices listed in the schedule shall aggregate the total contract price.

The Owner reserves the right to increase or decrease the individual items of prices listed in said schedule if the same shall appear to be unbalanced.

The Contractor shall, without additional charge, furnish from time to time, as requested, such additional segregations of costs as may be required by the Owner for the purpose of allocating costs of the various individual buildings, structures and each equipment installation therein or connected therewith.

CONTRACTOR'S PAYMENT REQUESTS (49)

The Contractor's payment requests shall be in form acceptable to the Owner and in conformity with the Schedule of Prices described in Section 48 hereof. Such payment requests shall be accompanied by the Contractor's sworn statement, in form acceptable to the Owner, setting forth the original amount of the contract, the net amount of changes therein, the amount of the contract as of the date of the sworn statement, the total amounts previously paid on account of the contract, the unpaid balance thereof and the total amount of the payment requested by the Contractor. Similar information with respect to each of the subcontractors for whom payments are requested shall be set forth in the sworn statement.



GENERAL CONDITIONS

LUMP SUM CONSTRUCTION CONTRACTS

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CONTRACTOR'S PAYMENT REQUESTS (49) (Cont'd.)

The Contractor shall, within fifteen (15) days from the date of the Owner's remittance, submit a receipt signed by each subcontractor, in form acceptable to the Owner, for the full amount of the sum included for such subcontractor in the Owner's remittance. Failure to submit such receipts shall justify the withholding of future payments by the Owner.

PAYMENTS TO CONTRACTOR (50)

Payments shall be made by the Owner in accordance with the terms of the contract agreement.

In case of delivery of materials, or prepared work which cannot be conveniently fixed in place, the Owner may, if it approves of what has been done, make payment on account of the same, which payment shall be reckoned one of the payments on account of the contract.

No materials or supplies delivered to the site of the work shall be removed therefrom without the written consent of the Owner.

No payment will be made to the Contractor for material not delivered upon the premises.

Neither payments made under the contract, nor the occupancy, use or operation, by the Owner, of the premises, including all buildings and installations, either partial or entire, shall be evidence of the performance of the contract, either wholly or in part, nor shall such payments be construed to be an acceptance of defective work or improper materials. No payment, final or otherwise, shall be construed to relieve the Contractor from his obligation to make good any defects arising or discovered in his work within the period of his guarantee, or to waive any specific obligation the Contractor may assume as to the durability of his work.

The Owner shall have the power to withhold payment if, in its opinion, the work is not being done or progressing satisfactorily, until such time as the progress or character of the work has, in its opinion, been made satisfactory.

PATCHING AND REPLACING OF DAMAGED WORK (51)

The Contractor shall be held responsible for all damage to the work that is caused by his work, workmen, or by his Subcontractors. Patching and replacing of damaged work, except as provided under the heading of "Glass Damage", shall be done as directed by the Resident-Engineer, but the cost of same shall be paid by the Contractor.

At completion of the work, damage to the buildings, drives, walks, underground and overhead work, etc., shall be made good to the satisfaction of the Owner at Contractor's expense.





GENERAL CONDITIONS

" LUMP SUM CONSTRUCTION CONTRACTS

PLANT ENGINEERING OFFICE

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GLASS DAMAGE (52)

When a Contractor is designated by Specifications or otherwise as the General Contractor, he shall be responsible for all breakage of or other damage to glass permanently installed in the buildings.

Where the breakage or other damage is known to have been caused by any Subcontractor, Contractor or other party not under the jurisdiction of the General Contractor, the breakage or damage shall be made good to the satisfaction of the Owner by the General Contractor and paid for by the Subcontractor, Contractor or party responsible for the breakage or damage.

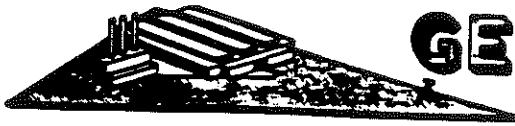
CONTRACTOR'S DEFAULT (53)

Should the Contractor fail to supply a sufficient number of properly skilled workmen or sufficient materials of proper quality, the Owner may, at its option provide such workmen or materials and deduct the cost thereof from any moneys then due or thereafter to become due to the Contractor or, should the Owner deem such failure, or the failure of the Contractor to prosecute the work with promptness and diligence, to constitute sufficient basis for such action, the Owner may terminate the employment of the Contractor. Written notice of termination of such employment shall be delivered to the Contractor's Superintendent or sent by registered mail to the Contractor, at least three (3) days prior to the effective date of termination specified in such notice. Upon service of such notice the Owner shall be at liberty, without prejudice to such other rights and remedies as may be available, to enter upon the premises, take possession of all materials, tools and equipment thereon and employ, upon such basis as to it may seem proper, any other person or persons to complete the work called for under the Contract.

SUSPENSION OF OPERATIONS (54)

The Contractor shall, upon the Owner's written request, suspend shipment and delivery of material and stop all work and operations hereunder for such period or periods of time as the Owner may deem advisable. Upon receipt of such notice, the Contractor shall immediately confer with the Owner relative to the reduction and possible elimination of the Contractor's field costs and with respect to such other prospective costs and expenses as may result directly from such work stoppage.

The Contractor will particularly note that reimbursements will in all cases be limited to his actual net costs and expenses for such items as shall have been agreed upon between the parties. Such costs and expenses shall be subject to audit by the Owner.



PLANT ENGINEERING OFFICE

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LUMP SUM CONSTRUCTION CONTRACTS

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TERMINATION BY OWNER (55)

The Owner may terminate this contract at any time, at the Owner's discretion, by the giving of written notice delivered to the Contractor, or sent by registered mail to the Contractor at least five (5) days prior to the effective date of termination specified in such notice. After receipt of notice of termination the Contractor shall terminate all work under the contract on the date specified in such notice and shall (1) terminate all orders and subcontracts chargeable to the performance on this contract, which may be terminated without costs; (2) terminate and settle, subject to approval of Owner, other orders and subcontracts where the cost of settlement will be less than costs which would be incurred were such orders and subcontracts to be completed; and (3) transfer to Owner, in accordance with Owner's directions, all materials, supplies, work in process, facilities, equipment, machinery or tools acquired by the Contractor in connection with the performance hereof and for which the Contractor is reimbursed hereunder, and all plans, drawings, working drawings, sketches, specifications and information for use in connection therewith. The Contractor shall, if directed by the Owner and to the extent stated in the Notice of Termination, do such work as may be necessary to preserve the work in progress and to protect material, plant and equipment on the work or in transit thereto.

Upon termination of this contract in accordance herewith and upon compliance by the Contractor with the provisions of the preceding paragraph, in any case other than for breach of this contract arising from fault of the Contractor, the Owner shall pay the Contractor in discharge of all obligations under this contract without duplication and only for (a) such portion of the work as the Contractor and his Subcontractors shall have completed, plus (b) the cost to the Contractor of materials which have been delivered to the plant site of the Owner up to the effective date of termination, plus (c) the cost to the Contractor of materials to be used in performance of this contract for which bona fide, irrevocable orders have been placed by the Contractor prior to the effective date of termination which have not been terminated and settled hereunder, provided that such materials are delivered to the Owner within a reasonable period after the effective date of termination, plus (d) the cost to the Contractor of terminating and settling orders and subcontracts in accordance with this provision, and plus (e) the cost to the Contractor of complying with the Owner's directions relative to the preservation of the work in progress and the protection of materials, plant and equipment on the work or in transit thereto. The payment to be made for any such completed portion of the work shall be in the proportion that the completed portion of the work bears to the entire work provided for in this Contract. Upon any such termination, "cost to the Contractor" as used herein shall include field and home office expense directly applicable to the Contract and not otherwise reimbursed hereunder; however, the Owner shall be under no obligation to pay the Contractor for anticipated profit on any portion of the work not completed. The Owner shall be under no obligation to compensate the Contractor under the provisions of this section if the contract is terminated because of the Contractor's breach of contract. The sum of all amounts payable under this provision, plus the sum of all amounts previously paid under this contract shall in no event exceed the total contract sum. Such costs and expenses shall be subject to audit by the Owner.





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TERMINATION BY OWNER (55) (Cont'd.)

In any and all subcontracts entered into between the Contractor and his Subcontractors and in any and all other commitments and obligations which the Contractor may undertake or incur, all in connection with the work under this contract, appropriate provisions shall be made to insure the most reasonable terms, in event of termination of the contract by the Owner, consistent with the provisions herein contained.

The provisions hereof shall not be deemed to limit the remedies granted to the Owner by the contract, or otherwise.

CLEANING OF PREMISES (56)

The Contractor shall at all times keep the entire premises free of rubbish and debris caused by his work and his employees, or by his Subcontractor, and upon completion of the work shall leave all buildings included in the contract broom clean. The Contractor shall also remove from the premises all items such as temporary partitions, office and storage sheds, fence material, etc., which were used for temporary purposes during construction.

Should the Contractor fail to do the required cleaning work immediately upon request, the Owner may employ men direct and charge the cost of same to the account of the Contractor.

GUARANTEE (57)

The Contractor shall execute and deliver to the Owner, before final payment, a written Guarantee, in form satisfactory to the Owner, that all labor and materials furnished and work performed by the Contractor are in accordance with the contract, plans and specifications and authorized alterations and additions thereto; and that, should any defect develop during the contract Guarantee period, as hereinafter defined, due to improper materials, workmanship or arrangement, the same, together with any other work affected in correcting such defect, shall, upon written notice, be made good by the Contractor without expense to the Owner.

The Guarantee shall be for a period of two (2) years from the date on which the completed work is turned over to and accepted by the Owner, unless a different period of time is elsewhere specified. Should the Guarantee required under any trade section of the specifications be for a period of more or less than two (2) years, the Contractor's Guarantee shall, with respect to such trade or trades, be for such longer or shorter period.

The Contractor's aforesaid Guarantee shall cover all work under the contract, whether or not any portion or trade has been assigned or sublet. In the event any portion of the work is performed by Assignees or Subcontractors, the Contractor shall obtain from such Assignees and Subcontractors their written Guarantee to the Owner covering their respective portions of the work for the periods specified and shall deliver same, together with his own Guarantee, to the Owner. Assignees' and Subcontractors' Guarantees shall expressly provide that the same shall be enforceable directly by the Owner, if it so elects, and shall run concurrently with the Contractor's Guarantee.

SECTION 1

SPECIAL CONDITIONS

1.1 GENERAL NOTE

The requirements of the Ford Motor Company General Conditions for Lump Sum Construction Contracts shall apply to this CONTRACT and to the following SPECIFICATIONS except as otherwise stipulated herein.

The requirements contained in the Ford Motor Company General Conditions which differ from any requirements contained in these Special Conditions shall be superseded by the requirements of these Special Conditions.

All references to the CONTRACTOR or the Earthwork Contractor (EWC) shall be construed to mean the General Contractor unless other modifying phrases are used in conjunction with the term.

The term RESIDENT-ENGINEER as used in the General Conditions shall mean the same person as the term CONSTRUCTION QUALITY ASSURANCE OFFICER as used in the Special Conditions and the technical sections of the SPECIFICATIONS.

1.2 MODIFICATIONS TO GENERAL CONDITIONS

Accident Prevention (26)

The CONTRACTOR shall appoint a qualified person to inaugurate, direct, supervise and enforce a safety program for all construction operations. Said person shall be on the job site during all hours of operation. The CONTRACTOR shall provide to the Owner a detailed written report of all accidents that occur at the site, regardless of the severity. The CONTRACTOR shall comply with provisions outlined in Appendix E of these Specifications entitled "Special Provisions Regarding Safety and Health (B)."

Liability Insurance (29)

- A. The CONTRACTOR shall procure and maintain insurance companies that are acceptable to OWNER, and before starting the work, shall provide OWNER with Certificates of Insurance covering: (a) statutory worker's compensation insurance, (b) employer's liability for not less than one million dollars (\$ 1,000,000), (c) general

public liability and property damage liability insurance, including contractual liability, with limits of not less than one million dollars (\$ 1,000,000) single limit per occurrence, and (d) automobile liability insurance, including all owned, non-owned or hired vehicles, with limits of not less than one million dollars (\$ 1,000,000) single limit per occurrence.

- B. The Certificates of Insurance required by this section shall provide that the policies under which insurance is effected may not be canceled or modified without thirty (30) days prior written notice to OWNER. The furnishing of such Certificates of Insurance shall not relieve the CONTRACTOR from any liability or obligation for which it would otherwise be responsible.
- C. The CONTRACTOR may, as an option, provide Certificates of Authority to self-insure worker's compensation in lieu of actual Certificates of Insurance for only those jurisdictions in which the CONTRACTOR is a qualified self-insurer.
- D. The CONTRACTOR'S Public Liability and Property Damage liability Insurance shall include a "Hold Harmless" clause which protects the ARCHITECT-ENGINEER from damage and liability caused by the CONTRACTOR'S negligence.

1.3 SITE EXAMINATION

The Contractor shall examine the site and compare the work called for in the drawings and specification with the existing field conditions.

The Contractor shall assume full and complete responsibility for deductions and conclusions he makes from his inspection.

1.4 DRAWINGS AND SPECIFICATIONS

The drawings are not all-inclusive and the Contractor shall include all items of work necessary to obtain complete systems, even though the items are not specifically called for on the drawings and the specifications.

1.5 PROJECT MATERIAL AND EQUIPMENT STATUS REPORT

Subsequent to the Owner's approval of subcontractors, suppliers, materials and equipment, and within seven (7) days after Contract Award Date, the Contractor shall submit a

Project Material and Equipment Status Report. At the request of the Owner, the Contractor shall furnish unpriced copies of purchase orders of material and equipment.

1.6 COMMENCEMENT AND COMPLETION OF WORK

The Contractor shall commence work under this contract immediately after notice of award by the Owner, and shall vigorously perform the work and shall complete his entire work by the completion date. The time stated for completion shall include final clean-up of the premises and all work for which he is responsible. All work shall be completed and turned over to the Owner by the completion date stated on the Construction Schedule.

1.7 OTHER CONCURRENT WORK

The Contractor is advised that other concurrent work may be conducted in the same area as the construction site. This Contractor shall coordinate his work with the other Contractors so as not to delay this Contract, or interfere with the operations of the other Contractors working in the area.

1.8 HOURS OF WORK

All work shall be performed during daylight hours, unless prior approval has been received from the Owner.

1.9 CONSTRUCTION EQUIPMENT

The Contractor shall keep on the job sufficient construction equipment to meet the requirements of the work. The equipment shall be in satisfactory operating condition, and capable of safely and efficiently performing the work as set forth in the specifications. All equipment shall be subject to inspection by the Owner at all times.

1.10 TEMPORARY PROTECTION

The Contractor shall provide all temporary illuminated barricades, enclosures or coverings necessary for the protection of the work until construction is completed. In addition, the Contractor shall provide all other protection required to properly safeguard the Owner's property and equipment, employees and the public.

1.11 ACCIDENT PREVENTION

In addition to the General Conditions requirements for "Accident Prevention", the Contractor shall comply with the State of Michigan Construction Safety Commission General Safety Rules and Regulations for the Construction Industry, effective June 9, 1965.

1.12 HEALTH AND SAFETY TRAINING

The Contractor shall utilize only health and safety trained personnel for the excavation and construction of the upper slopes in Cell II which may be in contact with old waste areas. Health and safety training will be considered to be documented completion of a OSHA training course conducted in accordance with 29 CFR 1910.120. A Health and Safety Plan shall be prepared and implemented by the Contractor consistent with all applicable federal and state regulations. An optional Guideline Health and Safety Plan, which is the sole responsibility of the Contractor, is provided in Appendix B.

1.13 USE OF PREMISES AND OWNER'S SECURITY REQUIREMENTS

The Contractor shall confine his working apparatus, the storage of materials, and the operations and movements of his workmen within the limits indicated by the Owner's rules and regulations and as directed by the Resident Engineer. The premises shall not be unreasonably encumbered with his materials.

The Contractor shall comply with the requirements of the Allen Park Clay Mine with regard to the entrance, movement within and exits of trucks and equipment. The Contractor shall coordinate all such operations with the Resident Engineer. The Contractor shall instruct each subcontractor regarding these security requirements of the Owner.

Contractor's vehicles shall be parked in areas as designated by the Owner.

1.14 ON-SITE OFFICE FACILITY

The Contractor will provide his own portable on-site office facility with telephone service.

1.15 WATER

Potable water is available at the site. Non-potable water for waterwagon dust control and construction purposes is available from the sediment pond.

1.16 ELECTRICITY

Limited electrical service is available on site; however, connection to the public utility is the responsibility of the Contractor.

1.17 TOILET FACILITIES

The Contractor shall provide his own portable toilets at the project site.

1.18 DISPOSAL OF WASTE MATERIALS

All waste materials resulting from contractor activities shall be removed from the premises and disposed of in accordance with applicable federal, state and local regulations. No burning of waste material will be permitted on the premises. All oils and fluids drained from equipment shall be collected for disposal off site. Excavation spoils may be disposed of at the site as approved by the Owner. No garbage may be disposed of on site.

The Contractor shall, at all times, keep the premises free from accumulation of waste materials or debris caused by his employees or work, and shall remove such materials when necessary or required by Owner.

1.19 ROAD CONDITIONS

The Contractor shall take all precautions to avoid depositing debris and mud on roads and streets adjoining and on the Owner's property from vehicles and equipment operating to and from the construction site, as part of the operations of this Contract. All trucks exiting the site must pass through the automatic wheel wash provided by the Owner. All trucks to and from jobsite shall be covered and will comply with all applicable Federal, State and Local laws and regulations.

1.20 CONSTRUCTION FUGITIVE DUST CONTROL

The earthwork contractor will be responsible for controlling site fugitive dust by employing a water-spraying truck. The requirements to comply with the facility's county-enforced fugitive dust control program are as follows:

1. Water spray all unpaved active roads at the rate of 0.13 gallons per square yard per hour of operation and,
2. Water spray all active truck unloading areas so as not to create visible emissions greater than 5 percent opacity using Test Method 9D from Michigan Act 348, as amended and,
3. Water spray (using high-pressure water) the paved entrance road at a minimum of two times per day of operations and,
4. Maintain records of all watering activity and submit daily to the facility office.

Note that the use of water as a fugitive dust control measure shall be suspended whenever:

1. Use of water could result in a freezing or safety hazard or,
2. Snow cover blankets the area to be treated or,
3. Where 0.10 inches or more of precipitation have fallen within the preceding 24-hour period.

1.21 PHOTOGRAPHS

Taking of photographs will not be permitted.

1.22 WATCHMAN

The Owner will not provide security patrols of the construction area either during or outside regular construction hours.

1.23 ENGINEERING

The Owner will designate vertical and horizontal control points for the Contractor. All other lines and grades shall be furnished by the Contractor. All layout work shall be performed by competent Engineers/Surveyors acceptable to the Owner.

The Contractor shall complete layout of the work and shall be responsible for all measurements and elevations that may be required for the execution of the work to the location and limits as shown on the Project Drawings.

The Contractor shall furnish, at his own expense, all instruments, surveys, stakes, templates, platforms, equipment, tools, materials, and all labor as may be required in laying out any part of the work.

1.24 "AS-BUILT" DRAWINGS

The Contractor shall maintain, at the job site, a complete set of construction, shop and installation drawings for all work under this Contract and shall record thereon all revisions and alterations to the work prior to acceptance by the Owner. Upon acceptance of the work, the Contractor shall make all recorded corrections to the drawings prepared by him and his Subcontractors before forwarding them to the Owner.

1.25 SHOP DRAWING SUBMITTAL PROCEDURE

In reference to Article No. 15 of the General Specifications regarding number and type of shop drawings to be submitted, the following criteria supersedes that portion of the referenced General Conditions Article.

The Contractor shall submit a clear, legible, reproducible mylar or brown line and one print for approval review; shop drawings shall be 24" x 36" size sheets. The Engineer will review the submittal and make appropriate comments on the reproducible mylar. The Engineer will reproduce sufficient number of copies for his use and the use of the Owner and will forward the marked reproducible to the Contractor. The Contractor shall revise the original tracing to agree with the mark-up and run copies for Contractor's use, the use of Subcontractors and for submittal to the Engineer for the Engineer's records.

The Owner reserves the right to disapprove shop drawings even through they have been returned "approved" by the Engineer. Shop drawings which deviate from the specified materials or equipment will be submitted by the Engineer to the Owner with recommendations prior to returning them to the Contractor. The Contractor must alert the Engineer when he submits shop drawings that deviate from the contract document.

Any deviations from the plans and specifications must have prior approval from the Owner, or his authorized representative.

1.26 OWNER'S RIGHT TO WORK

The Owner reserves the right to perform construction work similar in nature to the work included under these specifications in a nearby area on the site concurrently with the Contractor, with his own plant maintenance personnel, or with other contractors. It is the Contractor's obligation to cooperate fully to prevent conflicts which could affect the timely completion of work.

1.27 APPORTIONMENT OF WORK

The Contractor shall classify and apportion the furnishing of materials and the performance of labor to the various trades involved in accordance with local customs, rules, jurisdictional award, regulations and decisions insofar as they may be applicable to the work, regardless of the classifications indicated in the specifications.

1.28 METHOD OF CARRYING ON THE WORK

All work under this Contract shall be arranged and carried on in such a manner as to complete the work in the least possible time. The Contractor shall consult with the Owner as to the methods and sequence of carrying on the work so as not to interfere with the Owner's operation or delay the work of other Contractors as well as to space that may be available for material storage and place of access to work.

1.29 HIDDEN OBSTRUCTIONS

If, during excavation for new work, the Contractor uncovers a major man-made obstruction which is neither shown on the drawings of the existing conditions nor could be deduced to

be present from those drawings and could not be seen upon visual inspection of the area, the Contractor will be reimbursed by the Owner for the cost of removal or alterations, at a mutually agreed upon cost, but only if such condition is immediately brought to the attention of the Owner in writing. Method of removal or alteration shall be resolved with the Owner and such work shall not delay the construction schedule established for this project.

The Owner's operations must be maintained during the life of this Contract. Accordingly, the Contractor shall be required to conduct his work operations in the various areas to comply with the Owner's operational demands.

Should the Contractor's work, through no fault of the Owner, fail to progress according to schedule, and if, in the opinion of the Owner, or if deemed necessary to protect this or adjoining work from damage, the Contractor shall work such additional time over the normally scheduled hours of work, including Sundays and Holidays as required to meet the schedule time. No additional compensation will be allowed to the Contractor for such extended expenditures of work.

1.30 BULLETIN CHANGES

Requests for quotation of bulletins, as issued by the Owner or Owner's Engineer shall be quoted, complete with itemized breakdown and total costs, within seven (7) days of the date of issuance of the bulletin.

1.31 TESTING SERVICES

The Owner will retain a third party consultant to serve as an independent testing agency. The Contractor shall cooperate with the testing agency and provide such materials, equipment and services required to conduct the tests except technical equipment. Any information received from the testing shall be for the Owner's purposes and shall not relieve the Contractor of his responsibility for the work or removal and replacement of faulty work.

1.32 METHOD 2 - ALTERATION AND ADDITIONAL COSTS

- A. The alterations and additional covered in Method 2 - Section 44 of the General Conditions to which Contractors and Subcontractors fees are applicable, are the items of work that are not covered by the Contract unit prices.

B. The computations of the cost of these items of work shall be itemized in the proposal to show:

1. All direct labor required per item of work and labor rates including base rate, supervision, fringe benefits and insurance and taxes.
2. Quantity and cost of material used per item of work including applicable taxes.
3. Equipment rental cost.

C. The itemized breakdown of information and cost is required to permit check by the Owner to establish a fair valuation of the work.

1.33 PAYMENTS TO CONTRACTOR

In addition to all requirements outlined in these Specifications, the following shall also apply: All payments to Contractor will be subjected to a 10% retainer of the total amounts payable to the Contractor. The 10% retainer will be payable to the Contractor after the final acceptance of the Work as required by these Specifications and the Project Drawings by the Owner.

SECTION 2

GENERAL REQUIREMENTS

2.1 SCOPE OF WORK

The Contractor's scope of work consists of furnishing all labor, materials, supervision, equipment, and services necessary to complete construction of Allen Park Clay Mine - Cell II, as presented in these specifications except as noted below. The Contractor will also be responsible for the construction, maintenance, and, at the Owner's option, removal of all necessary temporary ramps, haul roads, and access roads suitable for the traffic anticipated, and any safety equipment, such as barricades, flashers, and signage. The Contractor shall be responsible for maintenance and protection of the work, including removal of rain water and seepage water. The Contractor shall provide and operate a water truck for dust control on the site and all associated access and haul roads.

The Owner will retain a qualified organization responsible for the supply and installation of geosynthetic material, except for pipe wrap material. The Owner will also provide the required survey controls for layout of the project. Controls lost through carelessness of the Contractor or his subcontractors shall be replaced by the Contractor with no additional cost to the Owner. Any additional controls which may be required during the course of the Work shall be the responsibility of the Contractor. The Contractor shall be responsible for all temporary construction staking needed to control the Work which shall be referenced to the survey controls provided by the Owner.

The Owner will purchase clay for the construction of the cell from a pre-approved clay supplier. The clay supplier will transport the clay from the supplier to the site in a condition acceptable to the Owner. It will be the Contractor's responsibility to coordinate with the Owner the time and quantity of clay material delivered to the site with the Owner.

All work described in these Detailed Specifications shall be constructed to the lines and grades shown on the Contract Drawings and in accordance with these Specifications. Any deviations from the Drawings or Specifications require the prior approval of the Owner and must be documented by "as-built" revisions to the Drawings. During all phases of the

construction, the work will be tested, inspected, and evaluated by the Engineer or Owner prior to approval.

2.2 WORK COVERED BY THIS CONTRACT

The Contractor shall construct Cell II as shown on the design drawings and specified herein. The work covered by this Contract will include, but will not be limited to the following:

- A. Construction of temporary access ramps and staging areas.
- B. Drainage of cell base and dewatering of excavations.
- C. Construction of stabilizing berms.
- D. Excavation, filling and grading of cell base.
- E. Excavation, filling and grading of cell sidewalls.
- F. Construction of perimeter berms.
- G. Construction of anchor trenches for cell liner.
- H. Fine grading of cell floor and sideslopes.
- I. Supply and installation of artesian seepage removal system, including controls.
- J. Coordinating the installation of secondary flexible membrane liner (FML).
- K. Supply and installation of secondary leachate removal system, including controls.
- L. Placement of compacted clay liner.
- M. Fine grading of clay liner, supply and installation of HDPE sumps.
- N. Coordinating the installation of primary flexible membrane liner (FML).
- O. Coordinating the installation of leachate collection drainage net and filter fabric on the side slopes.
- P. Supply and installation of leachate collection and removal system on the cell floor, including controls and temporary storm water diversion berms.

- Q. Final grading and vegetative cover.
- R. Surveying required to construct Cell II to specification.
- S. Facilitate taking of samples by the Independent Testing Engineer (ITE), performance of quality control field testing by the ITE, and surveying and inspections directed by the CQA Officer.

2.3 WORK PERFORMED BY FML MANUFACTURER/INSTALLER

The FML Manufacturer/Installer shall provide the following:

- A. Supply and install the Artesian Water Collection System drainage net and filter fabric lining the cell slopes and floor.
- B. Supply and install the Secondary and Primary Flexible Membrane Liners (FML).
- C. Supply and install the Secondary Leachate Collection System drainage net and filter fabric on cell side slopes and floor.
- D. Supply and install the Leachate Collection System drainage net and filter fabric on cell side slopes.
- E. Develop and submit to Ford QC inspection forms proposed for use in documenting field inspection activities associated with their own construction quality control/assurance program. These include but will not be limited to flexible membrane liner installations, leachate collection system installations, and artesian water collection system installations (Drainage Net and Filter Fabric).
- F. Provide all inspection documentation and test results per requirements of this specification.

2.4 CONSTRUCTION QUALITY ASSURANCE PLAN

A detailed Construction Quality Assurance Plan (CQAP) is included in the specifications in Appendix C. The CQAP is considered part of these Specifications.

A. Lines of Authority

Ford is the facility owner and operator and has overall responsibility for construction quality control testing

and quality assurance activities. Ford will appoint a Construction Quality Assurance (CQA) Officer who will be responsible to Ford, and will have final acceptance authority with respect to all phases of construction associated with this project. Each contracting and inspection company shall retain responsibility for the supervision of their own employees and the implementation of their own Quality Control/Assurance programs and for providing documentation to the CQA Officer as specified in this document. Acceptance or rejection of work, and implementation of the associated corrective actions shall be the responsibility of the CQA Officer.

B. Areas of Responsibilities

This section contains a description of the general division of responsibility between various parties to be involved in construction at the Allen Park Clay Mine Cell II. Detailed responsibilities are provided in appropriate sections of this document.

1. Ford Motor Company (Ford)

The Contractor as well as the CQA Officer are directly responsible to Ford as the Facility owner and site operator.

2. Construction Quality Assurance (CQA) Officer

The CQA Officer will be responsible for monitoring the Contractor's activities and for Ford's construction quality assurance personnel on site. The CQA Officer will be responsible for monitoring construction activities to verify that the work is completed in compliance with the design drawings and as specified herein.

Specific duties of the CQA Officer include: monitoring activities of personnel and contractors involved in the construction of Cell II, supervision of the Land Surveying Contractor (LSC) and Independent Testing Engineer (ITE) activities, monitoring quality of construction materials, acceptance/rejection of completed work, confirmation of as-built construction conditions in accordance with engineering plans and specifications, documentation of construction conditions, preparation of as-built construction documents, and certification that the Cell II flexible membrane liner and associated components are constructed as designed.

3. Independent Testing Engineer (ITE)

ITE representatives will conduct all laboratory testing required for soils used in construction and will perform field moisture content and density testing of soils during earthwork operations.

ITE representatives will perform QA/QC activities specified in appropriate sections of this Contract and will prepare daily field reports of construction observations as well as reports of laboratory tests.

4. Land Surveying Contractor (LSC)

Ford reserves the right to retain an Independent Land Surveying Contractor to verify as-built conditions and conformance to specified grades during Cell II construction. The LSC will provide all equipment and personnel needed to carry out its surveying activities. The LSC will report to the CQA Officer.

5. FML Installer (FMLI)

The FMLI shall be retained by the Owner. The FML Installer shall be the same as the FML manufacturer or an independent installer fully authorized by the manufacturer to install its liner. The FMLI shall install high density polyethylene (HDPE) flexible membrane liner at the locations shown on the engineering drawings. The FMLI shall conduct its own construction quality control/assurance program with respect to liner installation, pre-construction material inspection, in-place seam integrity testing and in-field pre-weld strength testing; and shall provide full documentation of liner installation and seam and raw material testing. The FMLI shall also supply Ford with the material test results as specified herein to be obtained from the liner manufacturer.

6. Net & Fabric Installer (NFI)

The NFI shall be retained by the Owner. The NFI shall have the experience and qualifications to install the net and fabric specified in these Specifications. The NFI shall install all synthetic drainage nets and fabrics at the locations shown on the engineering drawings, with the exception of fabrics used around collector pipes. The NFI shall supply material testing results generated by the manufacturer of these materials and inspect these materials for damage prior

to placement. The NFI shall conduct their own quality control/assurance program and shall document the placement of the synthetic drainage nets and fabrics according to the CQA document.

C. Qualifications

Minimum qualification requirements for various organizations involved with the construction of Allen Park Clay Mine Cell II are provided below.

1. FML Installer

The FMLI must be trained and qualified to install HDPE synthetic liners. Qualification requirements of the FMLI are included in Section 4 of this document.

2. Net & Fabric Installer

a. The NFI must be trained and qualified to install the drainage nets and filter fabrics specified in engineering design drawings.

b. To demonstrate necessary training and qualifications, the NFI must provide Ford with information relating to at least three previous projects. Information will include: name of project; location; date; names of installer's crew; type of net/fabric; thickness of net/fabric; surface area; type of seaming; duration of installation; and available information on the performance of the project. The NFI crew supervisor must have experience in seaming at least 100,000 square meters of drainage net filter fabrics.

3. Independent Testing Engineer

An independent testing organization capable of providing soil laboratory and field testing and construction observations will be retained by Ford. Personnel from the organization shall be under the supervision of the ITE who is licensed as a Professional Engineer, P.E., in the State of Michigan.

4. Quality Control/Assurance Officer

The CQA Officer shall be a licensed professional engineer with experience in land disposal facility construction similar to Allen Park Clay Mine.

5. Land Surveying Contractor

The LSC will be proficient in construction surveying techniques, and will have a Professional Surveyor or Engineer's license in the State of Michigan.

D. Meetings

1. Preconstruction Meetings

Prior to the start of work by any contractor, a preconstruction meeting will be held by the Owner or his representative. In this meeting, all involved parties will review applicable parts of the plans and this contract. In particular, the parties will review area of responsibility, lines of authority and procedures for dealing with problems or rejected work. The inspection frequency, document distribution and criteria for acceptance or rejection of work will also be discussed. The Owner or his representative will document each preconstruction meeting and distribute minutes of the meeting to other parties, as necessary.

2. Daily Work Meetings

Each work day, the Owner or his representative will conduct a meeting with all constructors, inspection firms and CQA personnel to review the previous day's work and to discuss the current day's scheduled work. Any coordination or workmanship problems as well as potential problems along with possible solutions will be discussed at that time. Pertinent safety issues will also be addressed. The Owner or his representative will document the meetings and distribute minutes to other parties, as necessary.

3. Meetings To Resolve Problems

These meetings will be held on the site as necessary when the immediate nature of a construction problem precludes discussion at the next scheduled daily work meeting. At such a meeting, the problem will be defined and discussed by all concerned supervisors. Possible solutions will be discussed and a solution will be selected. Implementation procedure of the chosen solution will also be discussed and agreed upon. The Owner or his representative will document the meeting and distribute minutes, as necessary.

SECTION 3

TECHNICAL SPECIFICATIONS

3.1 CONSTRUCTION PHASING

Cell II will be constructed and filled using a phased approach which is intended to maintain adequate slope stability throughout the construction process. The construction procedure consists of building Cell II in two phases. In the first phase, the perimeter slopes will be constructed to an interim elevation and the liner system will be installed to the interim elevation and anchored at the top of the interim slopes. Following Phase I construction, waste will be placed within the cell to approximately the interim slopes elevation. At that point, the perimeter slopes can be raised to the final grade elevations and the liner system can be extended and anchored at the top of the perimeter berms. The steps involved in this phased construction approach are shown schematically in the project drawings, and are discussed in detail below.

A. Phase I Construction

Phase I construction consists of the construction of the double composite liner system across the cell floor and up to the interim slope elevations shown on the design drawings. The double composite liner consists of an artesian water collection and removal system, a secondary flexible membrane liner, a secondary leachate collection and removal system, a 5-foot compacted clay liner, a primary flexible membrane liner and a leachate collection and removal system.

The anchor trenches for the various synthetic layers in the liner will be located as shown on the design drawings. The secondary liner system (artesian water collection and removal system, secondary FML, and secondary leachate collection and removal system) will be anchored in the top of the Phase I sideslopes. The primary liner system (primary FML and leachate collection system) will be anchored in the 5-foot compacted clay liner. The primary liner anchor trench is located at the bench to allow for welding of liner during Phase II construction. Anchor trenches at the top of the Phase I sideslope will be protected by constructing a compacted clay cover, as shown on the design drawings. Truck traffic will be routed away from anchor locations to prevent abrasion and other stresses on the liner system.

Geonet/geotextile will be encapsulated (on the bench and through the anchor trench) with a 20 Mil FML wrapping, as shown on the design drawings.

Filling of the cell will commence following completion of the construction of the liner system to Phase I shelf elevation. Filling will continue until the waste is at approximately elevation 600 msl in the center of the cell. The waste will be sloped down to a point approximately 30 feet away from Phase I shelf.

B. Phase II Construction

1. Perimeter Berm Construction

The first step of Phase II will be the construction of the perimeter berms to design grade. These berms shall be constructed at a slope of 2.5 horizontal to 1 vertical, in accordance with the specifications included herein. Construction of the perimeter berms will incorporate an 11-foot wide shelf at the elevation of the interim slopes. The 11-foot bench has been incorporated in the design to allow for welding of Phase I and Phase II liner systems on horizontal surface. This procedure is shown schematically on the design drawings.

2. Secondary Liner System Construction

Following construction of the perimeter berms, the secondary liner system for the upper portion of the cell sideslopes (i.e., perimeter berm) shall be installed as shown on the design drawings. Next, the clay cover (which is protecting the secondary liner system anchored at the interim slope elevation) shall be removed. The final 6 inches of the clay cover above the flexible membrane liner shall be excavated by hand. The secondary liner system shall then be pulled out of the anchor trench in approximately 50-foot sections and placed on top of the clay liner, where it shall be held in place with sandbags as shown on the design drawings. The various components of the secondary liner system will then be connected on the 11-foot horizontal shelf located at the top of the Phase I

sideslope. In addition, all construction observations, including weather, precipitation, etc., shall be recorded in daily construction field reports by the CQA officer.

3. Primary Liner System Construction:

Following connection of the secondary liner system, the clay over the primary liner anchor trench shall be removed, and the primary liner system pulled out and folded back onto itself in approximately 50-foot sections, as shown on the design drawings. The uncovered portion of the primary liner system shall be protected with temporary FML cover and held in place with sand bags. Phase II clay liner shall then be constructed and keyed into Phase I clay liner as shown on the design drawings. In addition, once construction of the clay liner has progressed above the bench, a 2-foot high temporary clay swale shall be constructed on the edge of the bench to divert surface water runoff away from the uncovered portion of the primary liner. After completely constructing the compacted clay liner, the primary liner system for the upper portion of the cell side slopes (i.e., perimeter berm) shall be installed as shown on the design drawings. After the installation of the primary liner system at the perimeter berm, remove the temporary clay swale at the bench and connect Phase I and Phase II primary liner system (i.e., primary 80 mil FML and primary leachate collection system geonet and geotextile) at the bench. In addition, all construction observations, including weather, precipitation, etc., shall be recorded in daily construction field reports by the CQA officer.

3.2 CONSTRUCTION SEQUENCE

A. Scope Of Work

The construction of Cell II shall include but is not limited to the construction of stabilization berms, construction of side slopes, construction of perimeter berms, preparation of cell floor, construction of a double composite liner system and surface preparation in accordance with specifications included herein.

To complete the Work by the required completion date, it will be necessary to construct some or all of the components simultaneously within different areas of the cell. This approach is used frequently in landfill cell construction, not only to expedite completion, but also to protect completed components as quickly as possible by the installation of the overlying components. Thus, the construction of Cell II will be expected to be staged. The details of the staging of construction are the responsibility of the Contractor, but must be submitted to the Owner and the Engineer for approval. Any changes to the initial approved staging plan must also be reviewed and approved by the Owner and Engineer. The Contractor needs to stage his work in such a manner that will not create situation which, in the opinion of the Engineer, will endanger the slopes.

B. Phase I Construction

1. Construct an access ramp at the northwest corner of the cell.
2. Provide drainage of the cell at approximately site coordinates N-3750 feet, E-7050 feet.
3. Construct and shape stabilization berm at the east slope.
4. Construct and shape stabilization berms at the north, west and south slopes.
5. Excavate cell bottom to achieve design grade including collection sumps.
6. Construct and shape north, west, and south side slopes and trench to design grade.
7. Construct anchor trenches for the secondary liner system as shown on design drawings. Remove sand pockets encountered during construction of anchor trenches, and replace with compacted clay as shown on design drawings.
8. Fine grade the cell floor and side slope for secondary flexible membrane liner (FML).

9. Install the artesian water removal system on the cell bottom including collection sump. Sump excavation shall be braced as shown on the design drawings.
10. Install the secondary leachate removal system on the cell bottom including collection sump. Sump excavation shall be braced as shown on the design drawings.
11. Remove access ramp at the southeast corner of the cell.
12. Install the secondary liner system (i.e. artesian water collection system, secondary flexible membrane liner and secondary leachate collection system) on the cell floor and side slopes starting at the east slope and working towards the west slope.
13. Construct new access roads at the northeast and southeast corners of the cell over the secondary liner system. These roads will become part of the primary clay liner.
14. Continue with secondary liner system installation and remove the access road at the northwest corner.
15. Place 5 feet of compacted clay on the cell floor and side slopes.
16. Construct anchor trench for the primary liner system as shown on the design drawings.
17. Install primary flexible membrane liner as shown on the design drawings.
18. Construct an access road at the northwest corner down to the stabilization berm at the north side.
19. Install HDPE leachate collection sump.
20. Install leachate collection net and fabric on the side slopes and stabilization berms.
21. Place 12-inch thick (1×10^{-2} cm/sec permeability) sand blanket on the cell bottom from the stabilization berm at the north side of the cell.
22. Install leachate collection piping system and drainage fabric on top of sand.

23. Install leachate pump and discharge system.
24. Install storm water diversion berms in accordance with design plans.

C. Phase II Construction

1. Construct perimeter berms to secondary liner elevation.
2. Construct anchor trenches for the secondary liner system as shown on design drawings.
3. Install secondary liner system on the upper slopes.
4. Connect Phase I secondary liner system to Phase II secondary liner system in accordance with section 3.1 of this specifications and as shown on the design drawings.
5. Construct the 5 feet clay liner on the side slopes as shown on the design drawings.
6. Construct anchor trenches for the primary liner system as shown on the design drawings.
7. Install the primary liner system on the side slopes and connect to Phase I primary liner system in accordance with section 3.1 of this specifications and as shown on the design drawings.

3.3 MOBILIZATION

A. Description of Work

The work to be performed under this section of Specifications will comprise the mobilization of excavation equipment, compaction equipment, support equipment, temporary facilities and personnel as required to perform the work detailed in this Contract.

B. Implementation

The Contractor shall mobilize within 10 working days of receiving notice to proceed.

C. Basis of Payment

The maximum allowance for Mobilization will be one and one half percent (1.5%) of the total bid base amount. The total allowance for mobilization will be payable to

the Contractor whenever he shall have completed mobilization and submitted a payment request in accordance with the General Specifications. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract.

3.4 EXCAVATION AND CONSTRUCTION

3.4.1 CONSTRUCTION OF SUBBASE STABILIZATION BERMS

A. Description of Work

This work shall consist of the construction of a compacted clay subbase and stabilization berms to be located along the base of the north, south, east and west cell sideslopes as shown on the Project Drawings.

B. Construction Sequence

1. Construct berms using the clay used in the construction of existing stabilization berm, off-site clay material supplied by the Owner, or stockpiled clay on-site.
2. Concurrently, excavate and backfill any cell floor areas exhibiting soft characteristics below existing ground surface and within the locations of the proposed stabilization berms. Excavation work at these locations shall be performed in sections. The width of the section is 50 feet or less in the direction parallel to the cell sides. No new excavation may take place until excavated area of the floor have been successfully backfilled to at least the initial floor elevation. Excavation may proceed as directed by the CQA Officer until suitable subgrade material is encountered. ~~Excavation spoil from this operation shall be removed from the cell, and stockpiled within the site as directed by the Owner.~~

C. Material Earthwork Requirements

1. Clay fill material shall be placed in horizontal lifts that do not exceed 9 inches in loose thickness.
2. Moisture/density restrictions that apply to clay intended for use in the subbase and berms are presented on Plate 1 attached to these specifications as Appendix A.
3. Fill material shall be compacted to not less than 90% of the maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D-1557) and moisture content shall be within a range of 0% to +5% of optimum at the time of placement. More restrictive limits may be applied, if needed, to achieve strength and permeability criteria specified herein.
4. Fill material used in base and berm preparation shall have a Unified Soil Classification (USC) of CL. After compaction, the permeability coefficient shall not exceed 1×10^{-6} cm/sec.
5. As shown on Plate 1, all fill placed within the location of the proposed stabilization berms shall have a minimum shear strength of 1500 psf.
6. All water, ice, snow and other frozen material shall be removed from work areas before placing any fill. No fill shall be placed on a frozen surface and no frozen fill shall be used for construction.
7. Foreign objects shall be removed from fill prior to placement.
8. Fill not meeting the in-place density, or water content, or strength or permeability requirements shall be reworked and re-compacted until all requirements are met.

D. Testing Requirements

1. The field density and moisture content of the compacted clay shall be determined by the ITE using the nuclear densimeter method (ASTM Standard D 2922 and D 3018) on a frequency of at least 1 test per 1000 cubic yards placed, with a minimum of 1 test per day of construction or 1 test per layer placed.
2. The moisture-density relationship of subbase fill and berm materials shall be re-determined by the ITE according to the Modified Proctor Compaction Test ASTM D-1557 when the texture of the soil changes and for every 5000 cubic yards placed. The grain size distribution, Atterberg limits and soil classification shall also be determined at this frequency.
3. A laboratory determination of the coefficient of permeability with moisture content shall be made on a soil sample obtained from every 10,000 cubic yards of material placed. Samples shall be obtained by the ITE by taking Shelby tubes from the compacted fill. Falling head permeability tests shall be performed according to one of the test methods detailed in USEPA publication SW-925 (1984). A coefficient of permeability greater than 1×10^{-6} cm/sec shall be immediately reported to the CQA Officer.
4. Shear strengths shall be determined by the ITE at a frequency of one test per day for materials placed with moisture contents within the ranges shown on Plate 1. If moisture contents are outside the specified ranges, or if soil characteristics change noticeably, shear strength tests shall be performed at a minimum of one test per 1000 yards of material placed. Shear strength will be determined by vane shear or torvane tests performed in the field. The frequency of shear strength testing may be increased at the discretion of the CQA Officer.

E. Responsibilities

1. The CQA Officer will monitor all earthwork operations during construction of the subbase, and stabilization berms.
2. The CQA Officer will be responsible for overall construction quality assurance of the cell subbase, and stabilization berms and will certify that the construction has been performed according to the Contract Drawings and these Specifications.
3. The Contractor shall survey base elevations following the placement of subbase fill to assure that base elevations are consistent with design grades shown on the Contract Drawings. The Contractor shall also survey the stabilization berms during construction to assure conformance with construction requirements and the Contract Drawings.
4. The Contractor shall fully cooperate with the ITE to facilitate the performance of the on-site testing and provide assistance (e.g. backhoe or dozer) to the ITE to procure sample necessary for the laboratory testing.
5. The Land Surveying Contractor (LSC) may perform survey checks on base and berm areas as directed by the CQA Officer.
6. The ITE will provide field density and moisture testing of fill placed.
7. The ITE will promptly notify the CQA Officer if materials or construction methods are not in accordance with Contract Drawings and these Specifications.
8. The ITE will sample and perform laboratory testing of soils at the frequency specified.

9. The ITE will provide documentation of the construction and CQA activities in the form of a daily field report. This report will be distributed to the CQA Officer and will contain the result of QC testing and other relevant information.
10. If the Contractor is found to be in non-conformance with any of the requirements of this section, the CQA Officer has the right to stop construction operation and inform the contractor of non-compliance. Construction operations shall not proceed until contractor fully complies with these requirements.

F. Basis of Payment

The amount for construction of subbase stabilization berms will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract. Earthwork operations in excess of those indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of completed bank yards of cut and fill earthwork quantities and the unit price indicated on the Unit Price Schedule of the Bid Form.

3.4.2 CONSTRUCTION OF CELL SIDESLOPES

3.4.2.1 Cut Slopes

A. Description of Work

As shown on engineering design drawings, some cutting of sideslopes will be performed in order to achieve design grades. Starting at the top of the slopes, cut to plan grade leaving 6-inches to 12-inches of excess material to protect against erosion if the slope face will not have the FML placed within

30 days. Excavated material shall be stockpiled outside the cell II boundaries and within the Allen Park Clay Mine site at locations designated by the Owner.

B. Material and Earthwork Requirements

1. Final cut slopes shall be rolled with a smooth steel drum, pneumatic roller or other suitable means satisfactory to the CQA Officer so as to be free of irregularities, loose earth, or abrupt changes in grade. Cut slopes shall be graded to smooth and true line.
2. Large objects, protruding stone and other sharp objects shall be removed by the Contractor from exposed surfaces on cut slopes. Generally, objects greater than 3/4 inches in diameter shall be removed in the upper 3 inches with no protrusions greater than 3/8 inches. Objects shall be removed by hand after the slope is cut.
3. The Contractor shall survey elevations at periodic intervals along the length of the slope to ensure that the slope meets design grades indicated on the Contract Drawings.

C. Responsibilities

1. Cutting of the sideslopes will be performed by the Contractor. These activities will be monitored by the CQA Officer.
2. Elevation checks may be taken by the LSC at the request of the CQA Officer.
3. The Contractor shall remove large, sharp, objects along the slopes.
4. The CQA Officer or his representative will inspect surfaces of the cut slopes to ensure that they are free of large, sharp objects as defined herein.
5. The CQA Officer will certify that cut slopes have been prepared in accordance with Contract Drawings.

3.4.2.2 Filled Slopes

A. Description of Work

As shown on the engineering design plans, fill will be placed in some areas along the Cell II sideslopes in order to achieve design grades in these locations. This fill shall have the following general specifications.

B. Material and Earthwork Requirements

1. Material used for fill shall be off-site clay obtained by the Owner. The Contractor shall provide a minimum of 48 hour notification to the Owner to allow the Owner to provide the off-site clay material for the Contractors backfill operations.

2. Clay fill material shall be placed in horizontal lifts that do not exceed 9 inches in loose thickness.
3. Moisture/density restrictions that apply to the clay intended for use in sideslope preparation are presented on Plate 1 attached to this specifications as Appendix A.
4. Fill material shall be compacted to not less than 90% of the maximum dry density as determined by a modified proctor compaction test (ASTM D-1557) and the moisture content shall be within a range of 0% to +5% of optimum at the time of placement. More restrictive limits may be applied, if needed, to achieve shear strength and permeability criteria specified herein.
5. Fill used in sideslopes will have a Unified Soil Classification of CL. After compaction, the permeability coefficient shall not exceed 1×10^{-6} cm/sec.
6. The compacted clay fill used in construction of sideslopes shall have a minimum shear strength of 1500 psf as shown on Plate 1 of this document. Sufficient sand shall be removed along the side slopes so that a minimum of 10 feet of re-compacted clay with permeability coefficient of less than 1×10^{-7} cm/sec is placed in these areas.
7. All water, ice, snow and other frozen material shall be removed before placing any fill. No fill shall be placed on a frozen surface and no

frozen fill shall be used for construction.

8. Foreign objects shall be removed from fill prior to placement.
9. Fill not meeting the in-place density, water content, strength and permeability requirements shall be reworked and re-compacted until all requirements are met.
10. Final slopes shall be rolled with a smooth steel drum, pneumatic roller or other suitable means satisfactory to the CQA so as to be free of irregularities, loose earth or abrupt changes in grade. Fill slopes shall be graded to smooth and true line.

C. Testing Requirements

1. The field density and moisture content of the compacted clay shall be determined by the ITE using the nuclear densimeter method (ASTM Standard D 2922 and D 3018) on a frequency of at least 1 test per 1000 cubic yards placed, with a minimum of 1 test per day of construction or 1 test per layer placed.
2. The moisture-density relationship of sideslope fill materials shall be re-determined by the ITE according to the Modified Proctor Compaction Test ASTM D-1557 when the texture of the soil changes and for every 5000 cubic yards placed. The grain size distribution, Atterberg limits and soil classification shall also be determined at this frequency.

3. A laboratory determination of the coefficient of permeability with moisture content will be made by the ITE on a soil sample obtained from every 10,000 cubic yards of material placed. Samples will be obtained by taking Shelby tubes from the compacted fill. Falling head permeability tests will be performed according to one of the test methods detailed in USEPA publication SW-925 (1984). A coefficient of permeability greater than 1×10^{-7} cm/sec shall be immediately reported to the CQA Officer.
4. Shear strengths shall be determined by the ITE at a frequency of one test per day for materials placed with moisture contents within the ranges shown on Plate 1. If moisture contents are outside the specified ranges, or if soil characteristics change noticeably, shear strength tests will be performed at a minimum of one test per 1000 yards of material placed. Shear strength will be determined by vane shear or torvane tests performed in the field.

D. Responsibilities

1. The CQA Officer will monitor all earthwork operations during filling on side slopes.
2. The CQA Officer will be responsible for overall construction quality assurance of the sideslopes and will certify that the construction is performed according to these Specifications.

3. The Contractor shall survey the sideslopes during construction to assure conformance with construction sequence requirements and final grades required by the Contract Drawings.
4. The Contractor shall fully cooperate with the ITE to facilitate the performance of the on-site testing and provide assistance (e.g. backhoe or dozer) to the ITE to procure samples necessary for the laboratory testing.
5. The LSC may perform survey checks on sideslopes to assure that sideslopes elevations are consistent with design grades as directed by the CQA Officer.
6. The ITE will provide field density, moisture and strength testing of fill placed and will promptly notify the CQA Officer of materials or construction methods not in accordance with the Contract Drawings and these Specification.

3.4.3 CONSTRUCTION OF PERIMETER BERMS

A. Description Of Work

As shown on the design drawings, perimeter berms will be constructed at the top of the sideslopes in conjunction with the excavation of anchor trenches for the synthetic liner material. Work performed under this section of the specifications will also include the removal of upper sand deposits and their replacement with compacted clay, as well as the collection and disposal of all leachate encountered during excavation operations for this task.

B. Material Earthwork Requirements

1. Clay fill material will be placed in horizontal lifts that do not exceed 9 inches in loose thickness.
2. Moisture/density restrictions that apply to clay intended for use in the perimeter berms are presented on Plate 1 attached to these specifications as Appendix A.
3. Fill material shall be compacted to not less than 90% of the maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D-1557) and moisture content shall be within a range of 0% to +5% of optimum at the time of placement. More restrictive limits may be applied, if needed, to achieve strength and permeability criteria specified herein.
4. Fill used in perimeter berm construction shall have a Unified Soil Classification (USC) of CL. After compaction, the permeability coefficient shall not exceed 1×10^{-6} cm/sec.
5. Fill material used in the construction of the perimeter berms shall have a minimum after compaction shear strength of 1500 psf as shown on Plate 1 attached to these specifications as Appendix A.
6. All water, ice, snow and other frozen material shall be removed from work areas before placing any fill. No fill shall be placed on a frozen surface and no frozen fill shall be used for construction.
7. Foreign objects shall be removed from fill prior to placement.
8. Fill not meeting the in-place density, water content, strength and permeability requirements shall be reworked and re-compacted until all requirements are met.

C. Testing Requirements

1. The field density and moisture content of the compacted clay shall be determined by the ITE using the nuclear densimeter method (ASTM Standard D 2922 and D 3018) on a frequency of at least 1 test per 1000 cubic yards placed, with a minimum of 1 test per day of construction or 1 test per layer placed.
2. The moisture-density relationship of clay intended for use in the construction of the perimeter berm shall be redetermined by the ITE according to the Modified Proctor Compaction Test ASTM D-1557 when the texture of the soil changes and for every 5000 cubic yards placed. The grain size distribution, Atterberg limits and soil classification shall also be determined at this frequency.
3. A laboratory determination of the coefficient of permeability with moisture content shall be made on a soil sample obtained from every 10,000 cubic yards of material placed. Samples shall be obtained by the ITE by taking Shelby tubes from the compacted fill. Falling head permeability tests shall be performed according to one of the test methods detailed in USEPA publication SW-925 (1984). A coefficient of permeability greater than 1×10^{-6} cm/sec shall be immediately reported to the CQA Officer.
4. Shear strengths shall be determined by the ITE at a frequency of one test per day for materials placed with moisture contents within the ranges shown on Plate 1. If moisture contents are outside the specified ranges, or if soil characteristics change noticeably, shear strength tests shall be performed at a minimum of one test per 1000 yards of material placed. Shear strength will be determined by vane shear tests or torvane performed in the field. The frequency of shear strength testing may be increased at the discretion of the CQA Officer.

D. Responsibilities

1. The CQA Officer will monitor all earthwork operations during construction of the perimeter berms.
2. The CQA Officer will be responsible for overall construction quality assurance of the perimeter berms, and will certify that the construction has been performed according to the Contract Drawings and these Specifications.
3. The Contractor shall survey base elevations following the placement of perimeter berms fill to assure that base elevations are consistent with design grades shown on the Contract Drawings. The Contractor shall also survey the perimeter berms during construction to assure conformance with construction requirements and the Contract Drawings.
4. The Contractor shall fully cooperate with the ITE to facilitate the performance of the on-site testing and provide assistance (e.g. backhoe or dozer) to the ITE to procure sample necessary for the laboratory testing.
5. The Land Surveying Contractor (LSC) may perform survey checks on berm areas as directed by the CQA Officer.
6. The ITE will provide field density and moisture testing of fill placed.
7. The ITE will promptly notify the CQA Officer if materials or construction methods are not in accordance with Contract Drawings and these Specifications.
8. The ITE will sample and perform laboratory testing of soils at the frequency specified.
9. The ITE will provide documentation of the construction and CQA activities in the form of a daily field report. This report will be distributed to the CQA

Officer and will contain the result of QC testing and other relevant information.

10. If the Contractor is found to be in non-conformance with any of the requirements of this section, the CQA Officer has the right to stop construction operation and inform the contractor of non-compliance. Construction operations shall not proceed until contractor fully complies with these requirements.

E. Basis of Payment

The amount for construction of perimeter berms will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract. Earthwork operations in excess of those indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of completed bank yards of cut and fill earthwork quantities and the unit price indicated on the Unit Price Schedule of the Bid Form.

3.5 PREPARATION OF CELL BASE FLOOR

A. Description Of Work

This work consists of excavation and fill as necessary to construct the base of Cell II to the final grades, as shown on the Contract Drawings.

B. Construction Sequence

1. Drain and dewater the entire base floor of Cell II.
2. Excavate and fill as necessary to establish the final grades as shown on the Contract Drawings. If in the opinion of the CQA Officer additional excavation is necessary, the excavation will proceed at the direction of CQA Officer until suitable subgrade material is encountered. All excavation spoil from this operation shall be

removed from the cell and stockpiled within the Allen Park Clay Mine property as directed by the Owner.

3. Remove all large stones, protruding objects and other debris from the cell base floor.

C. Material Earthwork Requirements

1. All water, ice, snow and other frozen material shall be removed from work areas before placement of any fill. No fill shall be placed on a frozen surface and no frozen fill shall be used for construction.
2. Material used for fill shall be off-site clay obtained by the Owner. The Contractor shall provide a minimum of 48 hour notification to the Owner to allow the Owner to provide the off-site clay material for the Contractors backfill operations.
3. Clay fill material will be compacted in horizontal lifts that do not exceed 9 inches in loose thickness.
4. Fill material shall be compacted to not less than 90% of the maximum dry density as determined by Modified Proctor Compaction Test (ASTM D-1557) and moisture content shall be within a range of 0% to 5% of optimum at the time of placement. More restrictive limits maybe applied, if needed, to achieve strength and permeability criteria specified herein.
5. Fill used in cell base floor preparation shall have a Unified Soil Classification (USC) of CL. After compaction, the permeability shall not exceed 1×10^{-8} cm/sec.
6. All cell base floor fill shall have a minimum shear strength of 1500 psf.
7. Foreign objects shall be removed from fill prior to placement.
8. Fill not meeting the in-place density, water content, strength and permeability requirements shall be reworked and re-compacted until all requirements are met.

D. Testing Requirements

1. The field density and moisture content of the compacted clay shall be determined by the ITE using the nuclear densimeter method (ASTM Standard D 2922 and D 3018) on a frequency of at least 1 test per 1000 cubic yards placed, with a minimum of 1 test per day of construction or 1 test per layer placed.
2. The moisture-density relationship of subbase fill materials shall be re-determined by the ITE according to the Modified Proctor Compaction Test ASTM D-1557 when the texture of the soil changes and for every 5000 cubic yards placed. The grain size distribution, Atterberg limits and soil classification shall also be determined at this frequency.
3. A laboratory determination of the coefficient of permeability with moisture content shall be made on a soil sample obtained from every 10,000 cubic yards of material placed. Samples shall be obtained by the ITE by taking Shelby tubes from the compacted fill. Falling head permeability tests shall be performed according to one of the test methods detailed in USEPA publication SW-925 (1984). A coefficient of permeability greater than 1×10^{-8} cm/sec shall be immediately reported to the CQA Officer.
4. Shear strengths shall be determined by the ITE at a frequency of one test per day for materials placed with moisture contents within the ranges shown on Plate 1. If moisture contents are outside the specified ranges, or if soil characteristics change noticeably, shear strength tests shall be performed at a minimum of one test per 1000 yards of material placed. Shear strength will be determined by vane shear or torvane tests performed in the field. The frequency of shear strength testing may be increased at the discretion of the CQA Officer.

E. Responsibilities

1. The CQA Officer will monitor all earthwork operations during construction of the cell base floor.
2. The CQA Officer will be responsible for overall construction quality assurance of the cell base floor and will certify that the construction has

been performed according to Contract Drawings and these Specifications.

3. The Contractor shall survey base elevations following the placement of cell floor fill to assure that elevations are consistent with design grades shown on the Contract Drawings.
4. The Contractor shall fully cooperate with the ITE to facilitate the performance of the on-site testing and provide assistance (e.g. backhoe or dozer) to the ITE to procure sample necessary for the laboratory testing.
5. The LSC may perform survey checks on base areas as directed by the CQA Officer.
6. The ITE will provide field density and moisture testing of fill placed.
7. The ITE will promptly notify the CQA Officer if materials or construction methods are not in accordance with Contract Drawings.
8. The ITE will sample and perform laboratory testing of soils at the frequency specified.
9. The ITE will provide documentation of the construction and CQA activities in the form of a daily field report. This report will be distributed to the CQA Officer and will contain the result of QC testing and other relevant information.
10. If the Contractor is found to be in non-conformance with any of the requirements of this section, the CQA Officer has the right to stop construction operations and inform the contractor of non-compliance. Construction operations shall not proceed until the Contractor fully complies with these requirements.

F. Basis of Payment

The amount for Preparation of Cell Base Floor will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract. Earthwork operations in excess of

those indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of completed bank yards of cut and fill earthwork quantities and the unit price indicated on the Unit Price Schedule of the Bid Form.

3.6 ARTESIAN WATER COLLECTION/REMOVAL SYSTEM (AWCRS)

A. Scope of Work

The Contractor shall furnish all labor, materials, supervision and equipment to construct the Artesian Water Collection/Removal System (AWRS) as indicated on the Contract Drawings. This work includes but is not limited to the supply and placement of the collection sump, piping, aggregate, geotextile wrap, backfill, riser pipes and pump.

The installation of the AWCRS (consisting of the geonet/geotextile combination) will be performed by the NFI through close coordination with the Contractor. At the cell floor the AWCRS consists of 5 foot wide strips of synthetic drainage net and fabric placed directly beneath the secondary 80 mil FML. At the side slopes and stabilization berms, the AWCRS consists of synthetic drainage net and fabric placed directly beneath the secondary 80 FML over the entire face of the side slopes and stabilization berms. The purpose of the system is to collect any groundwater seeping into the cell that could affect the stability of the liner. It is therefore imperative that this system be properly installed.

B. Materials

1. Geonet - To be supplied and installed by the NFI. HDPE drainage net Conwed-XB 8410 manufactured by Conwed Plastics or owner-supplied alternate shall be installed as shown on the design drawing.
2. Geotextile - To be supplied and installed by the NFI except that geotextile wrap around piping shall be supplied and installed by the Contractor. The geotextile shall be a nominal eight-ounce per-square-yard polypropylene, non-woven, needle-patched fabric. The geotextile shall be Propex 4508 manufactured by Amoco Fabrics and Fibers Company or Supac 8NP manufactured by Phillips Fibers Corporation, or owner-supplied alternative.

3. Piping - The AWCRS piping shall be 4" HDPE, SDR 11 (max) and be perforated along the bottom of the pipe with 2 rows of 1/4 inch holes at 4" intervals. The holes are to be placed 60 degrees apart. The riser pipe from the sump to the ground surface shall be 18" HDPE SDR 11 perforated per the plans. The pipes shall be manufactured by Plexco Inc.
4. Bedding and Backfilling - Pipe bedding and backfilling material shall be MDOT Series 6A. The bedding and backfilling material shall be free of foreign material, soil fines, and roots.
5. Sumps - The sump for the AWCRS shall be reinforced precast concrete, sized as indicated on the plans and be capable of withstanding the earth loads of the installation. The Contractor shall submit shop drawings of the sump for approval.
6. Pumps - The pump to be installed in the artesian water collection sump shall be capable of pumping 1-3 GPM at a head of 45'. The on-off operation of the pump shall be controlled by either a pressure transducer or a bubbler system supplied by the pump manufacturer compatible with this type of application. No check valve shall be located in the discharge line of the pump in order to allow the line to drain back to the sump after the pump completes it's cycle. The pumps shall be manufactured by EPG, American Landfill supply or equal.

The Contractor shall submit shop drawings for the pump, level control system and control panel for approval.

C. Construction

1. Preparation of Cell Base:

The Contractor shall be responsible for preparation and maintenance of the clay liner surface to receive the AWCRS until the AWCRS is permanently deployed. The clay liner surface condition must be visually inspected by and approved by both the Engineer and the NFI prior to deployment.

2. Excavation:

a. Dewatering:

- (1) Remove all liquid and frozen water, including rainwater, snow, and groundwater, encountered during the excavation. Water shall be discharged to Allen Drain.
- (2) Keep construction trench free from standing water.

b. Protection of Persons and Property

- (1) Barricade open holes and depressions occurring during performance of the work.
- (2) Protect structures, utilities, roadways, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by the operations during performance of the work.

c. Trenching

- (1) Trenching shall be used at the locations where the required depth to install the pipe is less than 10 feet. Pipe jacking techniques shall be used as described on the design drawings at the location where the required depth to install the pipe is more than 10 feet.
- (2) Provide necessary sheeting and shoring for protection of the Work and for the safety of personnel.
- (3) Prior to backfilling, remove all sheeting and shoring.
- (4) Excavate trench to the minimum width necessary for the proper installation of the toe drain cleat risers, with sides as nearly vertical as possible.
- (5) Grade trench within ± 0.1 foot of design grade with allowance for placement of bedding material.
- (6) The length of open trench excavation will be limited to the amount of pipe and backfill placement which can be completed in one working day.

3. Bedding

Place aggregate bedding material meeting requirements of this section of the Specifications in the trench bottom to the thickness indicated on the Project Drawings and shape to receive the pipe.

4. Piping

- a. The method of joining the pipes shall be done in strict conformance to the manufacturers specifications. The contractor shall submit at the time of pipe installation, the manufacturer of the pipe and their recommended method of pipe joining.
- b. The pipes must be installed within a tolerance of ± 0.1 feet from the design elevation. However, the pipes must be installed so as to maintain the minimum design slope depicted on the plans. The pipe installation shall include all fittings and caps as depicted on the drawings. Any blocking or templates used to raise the pipe off the geotextile must be removed so that the pipe is uniformly supported by the bedding aggregate along its entire length.
- c. Install pipe on properly prepared bedding material. Place pipe, in trench in such a manner so as to prevent kinking of the pipe.
- d. Install pipe so that the drainage holes are facing down. Installation tolerance is ± 0.1 foot from design invert elevation. Slope pipe evenly per plan slopes.

5. Backfilling

- a. Place aggregate backfill meeting the requirements of this section of the Specifications to one half pipe diameter and hand tamp so that adequate side support at pipe is achieved. Then place backfill to 6 inches above pipe and hand tamp once more.
- b. Remaining backfill shall be placed evenly across length of pipe in layers; however, no tamping is necessary. Mound aggregate backfill over trench as indicated on Project Drawings.

6. Geotextile Filter

- a. Place geotextile filter across the top of the completed drain trench backfill.
- b. Lap geotextile over soil and geonet/geotextile system on either side of trench by minimum distance of one foot, each side.
- c. Lap geotextile roll joints transverse to trench alignment by minimum distance of one foot.

7. Sumps

Installation of the AWCERS sumps shall be as indicated on the plans. The minimum excavation needed to install the sumps shall be completed to minimize the disturbance to the clay liner material. The sump excavations shall be braced per design drawings.

8. Geonet/Geotextile System

- a. The geonet/geotextile system shall be installed (by NFI) such that the geotextile is in direct contact with the clay and the geonet is over the geotextile as indicated on the drawings.
 - b. The minimum overlap of the geotextile shall be 4 inches. The geonet shall be placed edge to edge and shall be tied per manufacturers specification at a minimum of every 2 feet (by NFI).
 - c. All net and fabric shall extend upward into the anchor trench and be restrained there with compacted soil.
 - d. The Contractor shall coordinate with the NFI and phase the construction such that the AWCERS is left uncovered for no more than 48 hours and at all times is kept clean and free of mud, debris or any other material that would adversely effect its intended operation.
9. The AWCERS pump shall be installed as soon as the system is operable and prior to the FMLI installing the FML liner. The pump shall be installed per manufacturers instructions.

D. Responsibilities

1. Geonet/Geotextile System

- a. The NFI shall install drainage net and fabrics at the locations shown on the drawings.
- b. The NFI shall inspect all drainage net and fabric rolls stored on-site to verify that the proper materials have been received for the work. The NFI shall also inspect for any damage which may have been caused by mishandling during transportation, unloading or storage.
- c. The NFI shall document the overlap of nets and fabrics and shall inspect and document the method of joining/seaming of adjacent sheets.
- d. The NFI shall document the method of fastening.
- e. Upon completion of the AWCRS, the CQA officer shall verify total coverage and adequate fastening and restraint.
- f. The NFI shall submit written documentation to the CQA Officer verifying that drainage net and fabric has been installed according to engineering design plans and that in-place materials meet generally accepted standards of placement.
- g. The CQA Officer will certify that drainage nets and fabrics used in the pressure relief system have been installed according to cell engineering design plans.

2. Pipes

- a. The Contractor shall inspect all collection pipe and labeling prior to use to verify that it is made of the specified materials, that pipe dimensions and perforations are as specified, and that pipe is relatively clean internally. The CQA Officer will monitor these activities to verify that the requirements are met.
- b. The Contractor shall inspect all scuff pads to verify correct locations.

- c. The Contractor shall inspect the fusion-butt welding of the HDPE pipe and shall visually observe the pipe welding process to verify the proper joining of pipe.
- d. The Contractor shall inspect the collector pipe location and invert levels and verify configuration.
- e. The Contractor shall inspect the placement of fabric wrap and bedding material around the collection pipes, and document such observations.
- f. The CQA Officer will monitor all the above listed activities and may perform independent tests and surveys to verify construction is completed in accordance with design drawings and this specification.
- g. The CQA Officer will certify that pipes were placed in accordance with cell engineering design plans.

3. Sump Collection

- a. The Contractor shall construct a sump at the location shown on the drawings.
- b. The Contractor shall inspect and document the construction of the artesian water system and collection sump. The details and dimensions shown on the engineering plans shall be verified and documented by the Contractor.
- c. The LSC shall check elevations for the pipe inverts at the sump and for the bottom of the sump.
- d. The CQA Officer will observe these operations to verify compliance. the CQA Officer will certify that the pressure relief system collection sump has been installed in accordance with cell engineering design plans.

E. Measurement and Payment

- 1. Payment for the AWRS piping sumps and pump shall be on a lump sum basis.

2. The amount for AWCERS system installation will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of specifications in accordance with the Contract. Work in excess of that indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of the unit price indicated on the Unit Price Schedule of the Bid Form.

3.7 FML INSTALLATION

A. Scope of Work

The Contractor shall furnish all labor, materials, supervision, and equipment to assist in the installation of the geomembrane liner, including, but not limited to, anchor trench excavation and backfill and final preparation of clay liner surface, in accordance with the Contract Drawings and these Specifications. The geomembrane shall be installed by the FMLI. All technical aspects of the geomembrane deployment, seaming, patching, and testing shall be completed by a licensed installer acceptable to the manufacturer of the material. It is the Contractor's responsibility to assist in the coordination of his activities with those of the liner installer. The Contractor shall be held fully responsible for additional costs incurred as a result of failure to perform his duties in accordance with any established schedule or agreement to which the Contractor was in concurrence. All anchor trench earthwork and all manual labor not performed by full-time regular employees of the licensed installer subcontractor shall be provided by the Contractor.

B. Materials

All materials shall be provided by the FML manufacturer. The Contractor will be responsible for any damages to the liner material incurred as a result of the Contractors actions or activities.

C. Construction

Detailed specifications for the deployment, seaming, patching, and testing of the geomembrane liner are provided in Section 4 of these Specifications. More stringent requirements may be employed, if required by the licensed geomembrane installer's standard internal quality control procedures, with the approval of the Engineer.

D. Basis of Payment

The amount for work furnished by the Contractor under this section of the Specifications will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract. Work in excess of that indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of the unit price indicated on the Unit Price Schedule of the Bid Form.

3.8 SECONDARY LEACHATE COLLECTION/REMOVAL SYSTEM (SLCRS)
(LEAK DETECTION SYSTEM)

A. Scope Of Work

The proposed secondary leachate collection and removal system (SLCRS) will consist of layers of drainage net and fabric installed above the secondary FML. The SLCRS will be constructed in accordance with cell engineering design plans.

The Contractor shall furnish all labor, materials, supervision and equipment to construct the SLRS as indicated on the Contract Drawings. This work includes but is not limited to the supply and placement of the collection sump, piping, aggregate, geotextile wrap, backfill, riser pipes and pump.

The installation of the SLCS (consisting of the geonet/geotextile combination) will be performed by the NFI through close coordination with the Contractor. On the sideslopes, the SLCRS consists of one layer of drainage net covered with a continuous layer of fabric. On the cell floor, the SLCS consists of two layers of drainage net covered with a continuous layer of fabric.

B. Material

1. Geonet - To be supplied and installed by the NFI. On sideslopes, Conwed-XB 8410 HDPE drainage net or owner-supplied alternate shall be installed as shown on the drawings. On cell floor, Conwed-XB 8410 HDPE drainage net or owner-supplied alternate shall be installed as shown on the design drawings.
2. Geotextile - To be supplied and installed by the NFI except that geotextile wrap around piping shall be supplied and installed by the Contractor. The geotextile shall be 8 ounce non-woven polypropylene fabric.
3. Piping - The secondary leachate removal system piping shall be 4" HDPE, SDR 11 (max) and be perforated along the bottom of the pipe with 2 rows of 1/4 inch holes at 4" intervals. The holes are to be placed 60 degrees apart. The riser pipe from the sump to the ground surface shall be 18" HDPE SDR 11 perforated per the plans. Aggregate and geotextile wrap shall be as specified on Contract drawings.
4. Bedding and Backfilling - Pipe bedding and backfilling material shall be MDOT Series 6A. The bedding and backfilling material shall be free of foreign material, soil fines, and roots.
5. Sumps - The sump for the secondary leachate removal system shall be reinforced precast concrete, sized as indicated on the plans and be capable of withstanding the earth loads of the installation. The Contractor shall submit shop drawings of the sump for approval.
6. Pumps - The pump to be installed in the secondary leachate removal system shall be capable of pumping 1-3 GPM at a head of 45'. The on-off operation of the pump shall be controlled by either a pressure transducer or a bubbler system supplied by the pump manufacturer compatible with this type of application. No check valve shall be located in the discharge line of the pump in order to allow

the line to drain back to the sump after the pump completes its cycle. The pumps shall be manufactured by EPG, American Landfill Supply or equal.

The Contractor shall submit shop drawings for the pump, level control system and control panel for approval.

C. Construction Methods

1. Preparation of Liner Surface

The Contractor shall be responsible for preparation and maintenance of the secondary liner surface to receive the SLCRS until the SLCRS is permanently deployed. The secondary liner should be visually inspected by and approved by both the Engineer and the NFI prior to deployment.

2. Excavation

a. Dewatering

(1) Remove all liquid and frozen water, including rainwater, snow, and groundwater, encountered during the excavation. Water shall be discharged to Allen Drain.

(2) Keep construction trench free from standing water.

b. Protection of Persons and Property

(1) Barricade open holes and depressions occurring during performance of the work.

(2) Protect structures, utilities, roadways, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by the operations during performance of the work.

c. Trenching

(1) Trenching shall be used at the locations where the required depth to install the pipe is less than 10 feet. Pipe jacking techniques shall be used as described on the design drawings at the location where

the required depth to install the pipe is more than 10 feet.

- (2) Provide necessary sheeting and shoring for protection of the Work and for the safety of personnel.
- (3) Prior to backfilling, remove all sheeting and shoring.
- (4) Excavate trench to the minimum width necessary for the proper installation of the toe drain cleanout risers, with sides as nearly vertical as possible.
- (5) Grade trench within ± 0.1 foot of design grade with allowance for placement of bedding material.
- (6) The length of open trench excavation will be limited to the amount of pipe and backfill placement which can be completed in one working day.

3. Bedding

Place aggregate bedding material meeting requirements of this section of the Specifications in the trench bottom to the thickness indicated on the Project Drawings and shape to receive the pipe.

4. Piping

- a. The method of joining the pipes shall be done in strict conformance to the manufacturers specifications. The Contractor shall submit, at the time of pipe installation, the manufacturer of the pipe and their recommended method of pipe joining.
- b. The pipes must be installed within a tolerance of ± 1 feet from the design elevation. However, the pipes must be installed so as to maintain the minimum design slope depicted on the plans. The pipe installation shall include all fittings and caps as depicted on the drawings. Any blocking or templates used to raise the pipe off the geotextile must be removed so that the pipe is uniformly supported by the bedding aggregate along its entire length.

- c. Install pipe on properly prepared bedding material. Place pipe, in trench in such a manner so as to prevent kinking of the pipe.
- d. Install pipe so that the drainage holes are facing down. Installation tolerance is ± 0.1 foot from design invert elevation. Slope pipe evenly per plan slopes.

5. Backfilling

- a. Place aggregate backfill meeting the requirements of this section of the Specifications to one half pipe diameter and hand tamp so that adequate side support at pipe is achieved. Then place backfill to 6 inches above pipe and hand tamp once more.
- b. Remaining backfill shall be placed evenly across length of pipe in layers; however, no tamping is necessary. Mound aggregate backfill over trench as indicated on Project Drawings.

6. Geotextile Filter

- a. Place geotextile filter across the top of the completed drain trench backfill.
- b. Lap geotextile over soil and geonet/geotextile system on either side of trench by minimum distance of one foot, each side.
- c. Lap geotextile roll joints transverse to trench alignment by minimum distance of one foot.

7. Sumps

Installation of the SLCRS sumps shall be as indicated on the plans. The minimum excavation needed to install the sumps shall be completed to minimize the disturbance to the clay liner material. The sump excavations should be braced per design drawings.

8. Geonet/Geotextile System

- a. On sideslopes, one layer of drainage net shall be installed as shown on the drawings.

- b. On the cell base, two layers of drainage net shall be installed as shown on the drawings.
 - c. All drainage net shall be covered with a continuous layer of fabric.
 - d. The minimum overlap of the geotextile shall be 4 inches. The geonet shall be placed edge to edge and shall be tied per manufacturers specification at a minimum of every 2 feet (by NFI).
 - e. All net and fabric shall extend upward into the anchor trench and be restrained there with compacted soil.
 - f. The Contractor shall coordinate with the NFI and phase the construction such that the SLCS is left uncovered for no more than 48 hours and at all times is kept clean and free of mud, debris or any other material that would adversely effect its intended operation.
9. The SLCS pump shall be installed as soon as the system is operable and prior to the FMLI installing the FML liner. The pump shall be installed per manufacturers instructions.

D. Responsibilities

1. Geonet/Geotextile System

- a. The NFI shall install drainage net and fabrics at the locations shown on the drawings.
- b. The NFI shall inspect all drainage net and fabric rolls stored on-site to verify that the proper materials have been received for the work. The NFI shall also inspect for any damage which may have been caused by mishandling during transportation, unloading or storage.
- c. The NFI shall document the overlap of nets and fabrics and shall inspect and document the method of jointing/seaming of adjacent sheets.

- d. The NFI shall document the number of layers of the drainage net, the method of fastening different portions of the net, and the location of the secondary collectors as shown on design drawings plans.
- e. Upon completion of the secondary leachate collection system, the CQA officer shall verify total coverage and adequate fastening and restraint.
- f. The NFI shall submit written documentation to the CQA Officer verifying that drainage net and fabric has been installed according to engineering design plans and that in-place materials meet generally accepted standards of placement.
- g. The CQA Officer will certify that drainage nets and fabrics used in the secondary leachate collection system have been installed according to cell engineering design plans.

2. Pipes

- a. The Contractor shall inspect all collection pipe and labeling prior to use to verify that it is made of the specified materials, that pipe dimensions and perforations are as specified, and that pipe is relatively clean internally. The CQA Officer will monitor these activities to verify the requirements are met.
- b. The Contractor shall inspect all scuff pads to verify correct locations.
- c. The Contractor shall carry out the fusion-butt welding of the HDPE pipe and shall visually observe the pipe welding process to verify the proper joining of pipe.
- d. The Contractor shall inspect the collector pipe location and invert levels and verify configuration.
- e. The Contractor shall inspect the placement of fabric wrap and bedding material around the collection pipes, and document such observations.

- f. The CQA Officer will monitor all the above listed activities and perform independent tests and surveys to verify construction is completed in accordance with design drawings and this specification.
 - g. The CQA Officer will certify that pipes were placed in accordance with cell engineering design plans.
- 3. Sump Collection
 - a. The Contractor shall construct a sump at the location shown on the drawings.
 - b. The Contractor shall inspect and document the construction of the secondary leachate removal system. The details and dimensions shown on the engineering plans shall be verified and documented by the Contractor.
 - c. The LSC shall check elevations for the pipe inverts at the sump and for the bottom of the sump.
 - d. The CQA Officer will observe these operations to verify compliance. the CQA Officer will certify that the pressure relief system collection sump has been installed in accordance with cell engineering design plans.

E. Measurement and Payment

- 1. Payment for the SLCRS piping, sumps and pump shall be on a lump sum basis.
- 2. The amount for the SLCRS installation will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of specifications in accordance with the Contract. Work in excess of that indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of the unit price indicated on the Unit Price Schedule of the Bid Form.

3.9 PRIMARY 5-FOOT THICK CLAY LINER CONSTRUCTION

A. Scope Of Work

Construction of the 5-foot compacted clay liner will occur following base preparation and installation of the artesian water collection and removal system, secondary FML and secondary leachate collection and removal system.

B. Material Requirements and Methods of Construction

1. Clay soils used in the primary liner will have a Unified Soil Classification (USC) of CL, as determined by the provisions of ASTM Standard D 2487.
2. To avoid damage to the underlying secondary liner and secondary leachate system, the first 18" shall be leveled with low-ground pressure equipment. Equipment ground contact pressure shall not exceed 41.5 psi.
3. The remaining layers of CL material used in the compacted clay shall be placed in horizontal lifts that shall not exceed 9 inches (25 centimeters) in loose thickness.
4. The upper 3 1/2 feet of the clay in the liner shall be compacted pursuant to criteria set forth in Test Pad Results (Clay Liner Test Pad Construction Study by NTH Consultants, Ltd., dated April 1991). The clay soil shall be compacted to not less than 90% of maximum dry density, as determined by the modified proctor compaction test, ASTM Standard D 1557-78. Moisture content shall be within range of 0% to +5% of optimum moisture, as determined from the modified proctor compaction tests, ASTM Standard D 1557-78. More restrictive limits may be applied if needed to achieve sheet strength and permeability criteria specified herein.
5. The 3 1/2-foot compacted clay layer shall have a maximum permeability coefficient of 1×10^{-7} cm/sec.
6. Shear strengths of the compacted clay layer shall be at least 1500 psf.
7. The 5-foot clay liner shall be constructed such that the bottom liner and the sidewall liner are continuous and completely keyed together at all construction joints. Where necessary, surfaces to receive clay fill shall be moisture conditioned either by addition of water and scarification where desiccated, or by discing to reduce water content of the clay liner.

8. All ice, snow, and other frozen material shall be removed before placing any clay. No fill shall be placed on frozen surface and no frozen fill shall be used in construction.
9. Foreign objects shall be removed from the fill prior to placement.
10. Any material not meeting requirements of this specification shall be removed and replaced with suitable materials to the satisfaction of the CQA Officer.

C. Testing Requirements

1. The field density and moisture content of the compacted clay shall be determined by the nuclear densimeter method (ASTM D 2922 and D 3017) on a frequency of at least 1 test per each 1000 cubic yards of clay placed, with a minimum of 1 test per day of construction or 1 test per layer of clay placed. When using the nuclear densimeter technique for field testing of the compacted clay, care shall be taken to avoid puncture of the underlying geomembranes.
2. The moisture-density relationship of liner materials shall be re-determined according to ASTM Standard D 1557-78 when the texture of the soil changes and every 5000 cubic yards placed. The grain size distribution, Atterberg Limits, and soil classification shall also be determined at this frequency (ASTM D 2487, D 422, and D 4318).
3. A laboratory determination of the coefficient of permeability with water of a soil sample obtained from every 10,000 cubic yards of material placed will be made by the ITE. Samples will be obtained by Shelby tube sampling. During sampling, care must be taken to avoid puncture of the underlying geomembrane. Falling head permeability tests will be performed according to one of the methods detailed in USEPA publication SW-925 (1984). A resultant coefficient of permeability greater than 1×10^{-7} cm/sec will be immediately reported to the CQA Officer.
4. Shear strength will be determined by the ITE at a frequency of one test per day for materials placed with moisture contents within range of 0% to 5% of optimum moisture content. If moisture contents are outside the specified ranges, or if soil characteristics change

noticeably, shear strength tests will be performed at a minimum of one test per 1000 cubic yards of material placed. Shear strength will be determined by vane shear or torvane tests performed in the field. The frequency of shear strength testing may be increased at the discretion of the CQA Officer.

D. Responsibilities

1. The Contractor shall direct all earthwork operations during primary clay liner construction.
2. The LSC will perform surveying checks as specified herein and as directed by the CQA Officer.
3. The Contractor shall determine elevations of the top and toe of the sideslopes every 100 feet along the top and toe of the slope. This data shall be used with survey data collected before liner placement to determine clay liner thickness on the slopes. Locations determined to have less than 5 feet of compacted clay shall be reported immediately to the CQA Officer for correction action.
4. The Contractor shall perform a survey of the completed clay liner to verify proper lines and grades, in accordance with the engineering design plans. The thickness of the compacted clay liner shall not be less than 5 feet, as measured normal to the underlying synthetic layers. The clay liner surface elevations on the cell bottom shall be checked on a 100-foot grid and shall be accurate to within 0.2 feet.
5. The CQA Officer will be responsible for overall construction quality assurance of the primary clay liner and will certify that the construction is performed according to design drawings and this specification. The CQA Officer will monitor construction and gather sufficient backup data to allow the CQA Officer to certify that construction has been completed in accordance with design drawings and these specifications. The CQA Officer will direct surveying checks deemed necessary to verify that construction is completed in accordance with design drawings and this specification.

6. The ITE or his representative will sample soils and perform laboratory testing at the frequency required herein.
7. The ITE or his representative will provide field density, moisture and strength testing of fill placed and will promptly notify the CQA Officer of materials or construction methods not in accordance with specifications.
8. The ITE or his representative will provide documentation to the CQA Officer in the form of a daily field report including data of work, weather conditions, lift thickness, equipment used in construction, moisture and density test results, and any field strength test results.

E. Basis of Payment

The amount for Primary 5-Foot Thick Clay Liner will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract. Earthwork operations in excess of those indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis of completed bank yards of cut and fill earthwork quantities and the unit price indicated on the Unit Price Schedule of the Bid Form.

3.10 LEACHATE COLLECTION/REMOVAL SYSTEM

A. Scope of Work

The Contractor shall furnish all labor, materials, supervision, and equipment to install the leachate collection/removal system except as noted, including the leachate collection sump, and all incidentals necessary to complete the Work, including, but not limited to, the supply, hauling, spreading, and grading of the sand layer, the supply and installation of the lateral and header pipes with scuff strip, washed stone bedding and geotextile filter, and the supply and installation of all sump and extraction system materials, in accordance with the Contract Drawings and these Specifications. Supply and installation of Geonet/Geotextile system on sideslopes shall be performed by NFI.

B. Materials

1. The Contractor shall supply and install sand for the (primary) leachate collection system meeting the requirements of MDOT classification, "2NS," or Engineer approved equal, and having an installed, minimum hydraulic conductivity, as measured from re-compacted laboratory specimens of 1×10^{-2} cm/sec.
2. The Contractor shall supply and install materials for the leachate collection system lateral pipes and header pipes include perforated collection pipe and fittings, washed stone bedding, 5-foot wide minimum HDPE scuff strip, and geotextile filter wrap. Requirements for these materials are presented in the following section:
 - a. Collection Pipe: Collection pipes, both headers, shall be 8-inch diameter HDPE, SDR 7.3 (max). Collection pipes laterals shall be 6-inch diameter HDPE, SDR 7.3 (max). Both headers and laterals shall be perforated along the bottom of the pipe with 2 rows of 1/2 inch holes at 4" intervals. The holes are to be placed 60 degrees apart.
 - b. Washed Stone Bedding: The washed stone for bedding of the collection lateral and header pipes shall be MDOT 6A.
 - c. Geonet/Geotextile Filter System: To be supplied and installed by NFI, except that geotextile wrap around piping shall be supplied and installed by the Contractor. HDPE drainage net, Conwed-XB 8410 manufactured by Conwed Plastics, or owner-supplied alternate shall be installed as shown on the design drawings. The geotextile shall be a nominal 8-ounce per square yard polypropylene, non-woven, needle punched fabric. The geotextile shall be Propex 4508 manufactured by Amoco Fabrics and Fibers Co. or Supac 8NP manufactured by Phillips Fibers Corp., or owner-supplied alternate.
 - d. 60 mil Scuff Strip: The scuff strip shall be high density polyethylene with a nominal thickness of 60 mil, and shall be supplied by the FMLI. The Contractor shall be responsible for cutting 5-foot wide strips from standard rolls.

3. The leachate collection manhole and hose shall be as specified on the Drawings.
4. Pump - Pump shall be submersible non-clog wastewater pumps capable of pumping 100 GPM at 65 TDH. The pump shall be equipped with a 5 HP submersible motor connected for operation on a 480 volts 3 phase 60 hertz power supply. The pump shall be equipped with a 30' lifting chain or stainless steel cable rated at least 50% greater than the weight of the pump.

The pump shall be supplied with a 3" threaded discharge flange for connection to a flexible hose.

The pump shall be supplied with at least 400' of power cable properly sized according to NEC and ICEA standards and have P-MSHA approval.

The pump shall be manufactured by Flygt, Gould, ABS or equal.

The contractor shall submit shop drawing to the Owner for approval. The pump shall be controlled by means of float switches located in the sump. There shall be a pump on, pump off, and a high level alarm switch all wired to the control panel for controlling that pump operation. The control panel shall be as specified and located per the Project Drawings.

C. Construction

1. Upon successful completion of the geomembrane liner installation, the alignments of the leachate collection lateral and header pipes shall be covered by the Contractor with HDPE scuff strips provided by the Owner. Once a scuff strip is deployed, sand placement over the scuff strip and adjacent geomembrane liner shall commence as soon as possible to prevent loss of the scuff strip to wind. Wrinkling of the scuff strips shall be kept to a minimum to prevent affects on pipe grades.
2. Sand shall be deployed and graded by the Contractor over the geomembrane and scuff strips in such a way as to protect them from damaging contact with the deployment equipment and to minimize the generation of wrinkles in the geosynthetics. Any damage to the geomembrane or wrinkles caused by deployment which, in the Engineer's opinion, could endanger the integrity or service life of the geomembrane,

shall be repaired by the licensed geomembrane installer at the Contractor's expense. In general, wrinkles extending more than approximately 2 inches above what could reasonably be expected to fold over upon sand or refuse placement causing a stress concentration or crease, will require removal. Removal shall be either by "walking" out to a free edge of the geomembrane or by cutting and replacement of the wrinkled geomembrane. The sand surface shall be finish graded to ± 0.1 feet of the design elevations.

3. Once sand is deployed and graded over a sufficiently large area, the lateral and header pipe trenches shall be excavated by the Contractor using a Gradeall or other similar equipment providing a high degree of vertical control. Any damage to the underlying geosynthetics or clay liner resulting from the excavation of the pipe trenches shall be repaired at the Contractor's expense. Any repairs to the geomembrane shall only be completed by the licensed geomembrane installer.
4. The pipe trenches shall be lined with geotextile filter by the Contractor. The geotextile filter shall be overlapped a minimum distance of 12-inches between rolls. Sufficient geotextile flap shall be left to allow overlapping on top of the trench backfill by a minimum distance of 1 foot. The Contractor shall then lay the lateral and header perforated pipes and associated bedding stone as shown on the Drawings. The pipe shall be laid to maintain a minimum of 1 percent slope as measured between any two points along the pipe. In the final pipe trench procedure, the Contractor shall wrap the geotextile filter to close the envelope surrounding the bedding stone and cover the geotextile with a minimum thickness of 4-inches of stone. The surface of the sand adjacent to each pipe trench shall then be graded to form continuous, even surfaces around and up to the pipe trenches.
5. Geonet/Geotextile System Installation (By NFI):
On the side slopes and on the stabilization berms the geonet shall be deployed continuously on top of the FML liner with a minimum roll-to-roll overlap of 4 inches and tied with plastic ties at a maximum of 10 foot spacing. The geotextile shall be deployed continuously on top of the geonet with a minimum roll-to-roll overlap of one inch and machine sewn with a single stitch. The geotextile

shall then be stretched tight by hand to reduce bunching and to maximize coverage. This procedure shall be followed for both of the geotextile layers on the side slopes. The Contractor shall place sandbags on the slope in sufficient quantities to hold the geonet/geotextile in place. These shall be left in place for use by the Owner.

D. Testing Requirements

1. Granular System

- a. The Contractor shall advise the ITE of locations of proposed borrow sources. The ITE will obtain and test samples in accordance with requirements of this specification. Material testing on the granular blanket will be performed by ITE in advance of receipt of materials on-site to determine its grain size distribution (ASTM D 422), and permeability (ASTM D 2434). On the basis of these tests, the borrow source of the sand will be accepted or rejected by Ford. The Contractor shall obtain materials only from sources accepted by Ford.
- b. The permeability and aggregate classification of the sand shall be determined by the ITE for every 5000 cubic yards of sand placed to verify that the material is consistent with specifications contained within this document. A permeability of less than 1×10^{-2} cm/sec shall immediately be reported by the ITE to the CQA Officer.
- c. The depth of the sand shall be determined by the Contractor on a 100-foot grid by a survey or by direct depth checks. The records shall be submitted to the CQA Officer. The CQA Officer will spot check these measurements.

F. Responsibilities

1. Granular System

- a. The ITE's representative will perform laboratory testing on sand at the frequency specified in this document.
- b. The Contractor shall inspect the spreading of leachate collection sand and document sand material uniformity and the presence or

absence of foreign materials. The Contractor shall inspect this operation to detect potential and actual damage to the 80-mil FML. Where damage is suspected, the liner surface shall be exposed by the contractor to verify its condition. Actual damage shall be fully documented and corrective action shall be taken by the Contractor in accordance with requirements of their specification.

- c. The Contractor shall conduct survey operations on 1 100-foot grid to verify leachate collection sand thickness. Alternately, direct depth checks shall be used by the Contractor to verify sand thickness. Locations at which sand thickness is less than 12 inches shall be remediated by the Contractor under the direction of the CQA Officer.
- d. The CQA Officer will certify that the granular blanket has been placed in accordance with the engineering design plans. The CQA Officer will monitor these operations to verify compliance with requirements of this specification. The CQA Officer will direct surveying checks deemed necessary to verify that construction is completed in accordance with design drawings and this specification.

2. Pipes

- a. The Contractor shall inspect all leachate collection pipe and labeling prior to use to verify that it is made of the specified materials, that pipe dimensions and perforations are as specified, and that pipe is relatively clean internally. The CQA Officer will monitor these activities to verify that the requirements are met.
- b. The Contractor shall inspect all 30-mil HDPE scuff pads placed at leachate collector pipe and temporary berm locations to verify their presence and correct location. The location of scuff pads shall be marked on the sideslopes both before and after placement of synthetic materials.
- c. The Contractor shall inspect the excavation in the sand layer for placement of the collector pipe system to document any damage that may be

caused to the 80-mil FML by this operation. Corrective action shall be performed by the Contractor in accordance with requirements of this specification.

- d. The Contractor shall inspect the fusion-butt welding of the HDPE collector pipe and shall inspect the pipe welding process to verify the proper joining of pipe.
- e. The Contractor shall inspect the collector pipe location and configuration and proper placement of leachate collector pipe cleanouts.
- f. The Contractor shall inspect the placement of fabric wrap and bedding material around leachate collector pipes, and document such observations.
- g. The Contractor shall inspect the placement of the pea gravel around the leachate collector sump to verify correct placement and character of the pea gravel as shown on the drawings.
- h. The CQA Officer will monitor all these operations to verify compliance with requirements of this specification.
- i. The CQA Officer will certify that pipes were placed in accordance with cell engineering design plans.

3. Drainage Nets and Fabrics

- a. The NFI shall install drainage net and fabrics at the locations shown on the drawings.
- b. The NFI shall inspect all drainage net and fabric rolls stored on-site to verify that the proper materials have been received for the work. The NFI shall also inspect the materials for any damage which may have been caused by mishandling during transportation, unloading or storage.
- c. The NFI shall document the overlap of nets and fabrics and shall inspect and document the method of joining/seaming of adjacent sheets.
- d. The NFI shall document the number of layers of net and the method of fastening.

- e. The CQA Officer will monitor all these activities to verify that construction is completed in compliance with these specifications.
 - f. Upon completion of the leachate collection system, the CQA Officer and the NFI together shall verify total coverage and adequate fastening and restraint.
 - g. The NFI shall submit written documentation to the CQA Officer that drainage net and fabric has been installed according to engineering design plans and that in-place materials meet generally accepted standards of placement.
 - h. The CQA Officer will certify that drainage nets and fabrics used in the leachate collection system have been installed according to cell engineering design plans.
4. Sump collection
- a. The Contractor, NFI and FMLI, shall construct sumps at the locations shown on the drawings.
 - b. The Contractor, NFI and FMLI, shall inspect and document the construction of the primary leachate collection sump. Items requiring documentation include, but are not limited to the following: placement of HDPE liners under the sump and welding them to the primary liner, placement of the precast concrete base for the leachate sump, placement of the polyethylene leachate sump, inspection of the concrete poured around the sump, and proper fastening of leachate collector pipes and HDPE liners to the leachate sump. HDPE materials shall be connected using an extrusion welding process in which a heat gun heats the HDPE surface and extrudes liquid HDPE to bond individual HDPE pieces. In all of the above operations, each detail and dimension shown in the engineering plans will be verified and documented by the CQA Officer. Deviations of as-built conditions from engineering plans shall be corrected by the Contractor to the satisfaction of the CQA Officer.

- c. The Contractor shall determine elevations for the pipe inverts at the sump and for the bottom of the sump.
- d. The CQA Officer will examine the polyethylene leachate sump and shipping certificates to verify that it is made of proper material type and is of specified dimensions. The examinations shall verify pipe type, dimensions and perforations in accordance with engineering plans, and that it is relatively clean.
- e. The CQA Officer will certify that the leachate collection sump has been installed in accordance with cell engineering design plans.

F. Basis of Payment

The amount for Leachate Collection/Removal System will be payable to the Contractor by monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, equipment and incidental work necessary to complete this section of Specifications in accordance with the Contract. Work in excess of that indicated on Project Drawings and this section of these Specifications and authorized by the Owner or CQA Officer shall be payable to the Contractor on the basis the unit price indicated on the Unit Price Schedule of the Bid Form.

3.11 SURFACE RESTORATION

A. Scope of Work

The contractor shall furnish all labor, materials, (except topsoil), supervision, and equipment to restore all disturbed surfaces including but not limited to the excavation areas, stockpile areas, equipment storage areas (except roadways). The work shall include but not be limited to the grading, topsoiling, fertilizing, mulching and watering as required.

Definition of terms shall be as defined by MDOT 6.53.01

B. Material

The materials for mulch, seed, and fertilizer shall be as specified by MDOT Sec. 6.53.02 for roadside use except as indicated below:

Topsoil Specifications

1. A layer of topsoil at least 6 inches thick after grading must be placed over the clay.
2. The topsoil shall consist of the dark, organic, natural surface soil encountered on the project, exclusive of any peat or muck. Topsoil furnished from outside shall be approved by the Engineer.
3. The top 1/2 inch of the topsoil layer must be loosely packed to provide an acceptable seed bed.

Vegetative Cover Specifications

1. The topsoil must be fertilized with 12-12-12, N-P-K at the rate of 650 pounds per acre.
2. The following seed mix must be sown into the topsoil:

<u>SEED</u>	<u>% BY WEIGHT</u>
a. Common Cereal Tye	20 to 30
b. Common Creeping Red Fescue	20 to 30
c. Common Kentucky Bluegrass	5 to 10
d. Kentucky 31 Tall Fescue	100 - (a+b+c)

3. The seed mix must have a germination rate of at least 80%.
4. The seed mix must be applied at the rate of at least of 200-225 pounds per acre.
5. The seed bed must be rolled during or immediately after seed application.

6. Straw mulch must be applied to the seed bed at the even rate of 1.5 to 2 tons per acre in a manner that will minimize subsequent displacement by wind.

The Owner shall supply the needed topsoil for the work.

C. Construction

The construction methods for surface preparation shall conform to MDOT Sections 6.53.03 through 6.53.05 and 6.53.09.

D. Measurement and Payment

The amount bid for Surface Restoration of all disturbed areas will be payable to the Contractor in monthly progress payments based on "percent complete" up to the lump sum amount as indicated on the Bid Form. The amount as indicated on the Bid Form will constitute full compensation for all labor, material, equipment and incidental work necessary to complete this section of the Specifications in accordance with the Contract.

SECTION 4

FLEXIBLE MEMBRANE LINER

***TECHNICAL SPECIFICATIONS
FOR THE PROCUREMENT AND INSTALLATION
OF A GEOMEMBRANE LINER***

FOR

***CELL II
FORD ALLEN PARK CLAY MINE LANDFILL
ALLEN PARK, MICHIGAN***

***JULY 1991
REV. JANUARY 6, 1992***

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1.0 INTRODUCTION

1.1 Background

This document contains the technical specifications to be used for procuring and installing 80-mil geomembrane used in the primary liner for disposal Cell II at the Ford Allen Park Clay Mine (APCM) Landfill. A copy of the engineering plans prepared by MCI, dated October 1, 1991 are included and should be referenced for information pertinent to the preparation of bids.

1.2 Purpose and Scope

The work includes furnishing all labor, materials, transportation, supervision, tools, and construction machinery which may be necessary to unload, store, weather-protect for storage, deploy, weld, temporarily restrain (against the wind), install and test the geomembrane as described in these specifications and the associated engineering plans.

All procedures, operations, and tests will be performed in strict accordance with these specifications and the associated engineering plans. The installed geomembrane will conform to the specifications and engineering plans, except where authorized in writing by Ford Motor Company (Ford), based on submitted changes and/or modifications.

These specifications assumed that the roles of the Geomembrane Supplier and Geomembrane Installer are being performed by one party capable of providing all services required for supplying and installing the referenced geomembrane. The term geomembrane installer, therefore, refers to either the Geomembrane Supplier or Geomembrane Installer.

The Installer will install both a primary and secondary high density polyethylene (HDPE) flexible membrane liner at the locations shown on the engineering plans. The Installer will conduct his own construction Quality Assurance/Quality Control (QA/QC) program with respect to liner installation, pre-construction material inspection, in-place weld integrity testing and in-field pre-weld strength testing. The Installer will provide full documentation of liner installation, weld testing, and raw material testing. The Installer will also supply Ford with the material test results, as required, from the Geomembrane Manufacturer.

1.3 Lines of Authority

Ford is the facility owner/operator and prime contractor and has chief responsibility for construction completion and construction Quality Assurance/Quality Control. The CQA Officer, appointed by and responsible to Ford, shall have final authority with respect to all phases of construction associated with this project. Each contracting and inspection company shall retain responsibility for the supervision of his employees and the implementation of his

QA/QC programs. Supervisors assigned by each contracting or inspection company will be under the direction of the CQA Officer. Acceptance or rejection of work, and implementation of the associated corrective actions will be the responsibility of the CQA Officer.

1.3.1 Independent Testing Engineer (ITE)

An Independent Testing Engineer (ITE) will be retained by Ford for the project. The ITE or his representative will conduct laboratory testing for soils used in construction and will perform field moisture content and density testing of soils during earthwork operations. The ITE or his representative will also observe the installation of the HDPE primary liner.

The ITE or his representative will perform QA/QC activities specified in appropriate sections of the CQA Plan and will prepare daily field reports of his observations as well as reports of laboratory tests.

1.3.2 Construction Quality Assurance (CQA) Officer

The CQA Officer will be responsible for monitoring all contractors and construction quality assurance personnel on site. The CQA Officer will be responsible for construction monitoring, construction inspection and assuring that the work, as shown on the engineering plans and as specified herein, is completed.

Specific duties of the CQA Officer include: overall monitoring of personnel and contractors involved in construction; coordination between the various contractors; inspection of construction materials; acceptance/rejection of completed work; confirmation of as-built construction conditions in accordance with engineering plans and specifications; documentation of construction conditions; preparation of as-built construction documents; and certification that the Cell II liners and associated components are constructed as designed.

1.4 Meetings

1.4.1 Preconstruction Meetings

Prior to the start of work by a contractor, the CQA Officer will hold a preconstruction meeting. At the preconstruction meeting, all involved parties will review applicable sections of the plans and specifications, as well as the CQA Plan. In particular, the parties will review and discuss areas of responsibility; lines of authority; procedures for dealing with problems; rejected work; inspection frequency; documentation distribution; and the criteria for work acceptance/rejection. The CQA Officer will document and distribute minutes of each meeting to all parties in attendance, as necessary.

1.4.2 Daily Work Meetings

Each work day, the CQA Officer or his representative will conduct a meeting with all contractors, inspection firms and CQA personnel to review the previous day's work and to discuss the current day's scheduled activity. Coordination and workmanship issues, as well as potential difficulties, will be resolved at this time. The CQA Officer or his representative will document and distribute minutes of each meeting to all parties in attendance, as necessary.

1.4.3 Meetings to Resolve Problems

Meetings will be held on-site whenever the immediate nature of a construction issue precludes discussion at the next scheduled daily work meeting. At such a meeting, the issue(s) will be defined and discussed by all affected supervisors. A resolution and the procedure in which to implement it will be selected at such meeting, following discussion. The CQA Officer will document the meeting and distribute minutes of each meeting to all parties in attendance, as necessary.

2.0 MANUFACTURING

This section describes the quality control measures that are applicable to the manufacturing of geomembrane and the delivery of finished roll product to the APCM Landfill site, prior to installation.

Geomembrane will be supplied to the site in factory rolls. Factory welds and/or seams are *not* acceptable methods for preparing larger geomembrane panels for delivery to the site.

The geomembrane must be fabricated from polyethylene resin, and the *finished* product must be classified Type II or III, Class C, and Category 4 or 5, as defined by ASTM D1248. (This classification is based on tests performed on the *finished* product, *not* the polyethylene resin used to fabricate the geomembrane.)

2.1 Geomembrane Resin

The geomembrane will be manufactured from polyethylene resin that meets the following specifications:

Specific Gravity	ASTM D792, Method A	≥ 0.940 (Note: Measured after adding carbon black)
Melt Index	ASTM D1238, @ 190°C & 2.16 kg	0.15 - 0.70 gms per 10 mins
Water Absorption	ASTM D570	$\leq 0.1\%$

2.2 Quality Control Testing

Quality control testing will be performed by the Installer, as described in this section. Prior to the delivery of geomembrane rolls to the site, the Installer will provide the CQA Officer with the following information:

1. The resin supplier, location of supplier's production plant(s), resin brand name, production date of the resin, and the product number.
2. All test results conducted by the Installer's and/or the Resin Manufacturer's testing laboratories to document the quality of the resin used for the manufacture of the geomembrane.

3. The Quality Control Plan to be used for manufacturing and installing the geomembrane.
4. Quality Control Certificates issued by the producer of the raw materials; specifically results of density and melt index.

The Installer will provide the following results, at the stated frequencies, on the raw resin and will report such results to the CQA Officer:

1. A minimum of one sample will be collected and tested for the parameters in Item #2 below for every resin batch and for every 500,000 square feet of finished geomembrane product delivered to the site by the Installer.
2. Perform, at the frequencies stated in Item #1 above, specific gravity by ASTM D792 Method A; melt flow index by ASTM D1238 with a load of 2.16 kg at 190°C; and water absorption by ASTM D570.

If at any time during the manufacture of the geomembrane rolls (to be installed at this site and covered by the engineering plans) the Manufacturer uses, in whole or in part, resin from another supplier or a different brand of resin by the same supplier, the Installer must obtain approval from Ford to use the new resin, in accordance with the facility's RCRA Permit.

Every roll of geomembrane designated for delivery to the site must be inspected by the Installer in accordance with the following:

1. Quality polyethylene resin will be used, containing no more than 2 percent recycled polymer, by weight, as determined by Thermo Gravimetric Analysis. Recycled polymer will be limited to material generated within the Manufacturer's plant and from the same grade and type of polyethylene resin, as defined in this document.
2. The geomembrane will contain a *maximum* of 1 percent by weight of additives, fillers, or extenders, excluding carbon black.
3. The geomembrane will have no striations, roughness, pinholes, significant creases (as determined by the CQA Officer), or bubbles on the surface.
4. The geomembrane must be free of holes, blisters, undispersed raw materials, and other signs of contamination from foreign matter.

2.3 Manufacturer's Certification

The Installer will provide certification, based on tests performed by either the Installer's laboratory or other outside laboratory contracted by the Installer, that the geomembrane supplied under this plan meets the following:

1. Geomembrane meets the following specifications for resistance to soil burial criteria in accordance with ASTM D3083, as modified by Appendix A in the National Sanitation Foundation document, "Standard Number 54 - Flexible Membrane Liners" (1990 Revision) or *Certification* from the Supplier that the material will not be affected by biodegradation:

<u>Property</u>	<u>Maximum percent change for 80-mil geomembrane</u>
Tensile strength at yield	10
Tensile strength at break	10
Elongation at yield	10
Elongation at break	10
Modulus of elasticity	10

2. Geomembrane meets a -40°F (-40°C) maximum temperature for low temperature brittleness as determined by ASTM D746, Procedure B.

2.4 Fingerprint Tests

The Installer will randomly select a representative material sample of the actual thicknesses of geomembrane to be installed in the primary/secondary liners prior to the shipment of any geomembrane rolls to the site. The Installer will perform the following fingerprint tests to demonstrate that the geomembrane being installed under this plan is substantially the same geomembrane as that used for compatibility testing:

<u>Test</u>	<u>Test Method</u>
Crystallinity	ASTM E793 using a 20°C-per-minute scan rate @ 30 psi nitrogen atmosphere, and an indium standard
Infrared Spectroscopy	ASTM 3015
Melt Flow Index	ASTM D1238 with a load of 2.16 kg @ 190°C
Differential Scanning Calorimetry	ASTM D1603
Thermo Gravimetric Analysis	Use the method described in Charles M. Earnest Modern Thermogravimetry: Analytical Chemistry: 56(13);1471A, 1984 with a 40°C-per-minute scan rate and a 30 psi nitrogen atmosphere or equivalent method as approved by the CQA Officer

The results of the above tests will be sent by the Installer to the CQA Officer. The CQA Officer will make the final determination as to whether the geomembrane tested is substantially the same as that tested in the facility document, *Material Conformance and Compatibility*. The CQA Officer will notify the Installer of his decision. If the CQA Officer determines that the results of the above tests are substantially different from those obtained from the Compatibility Testing Program, then the entire program described in this section will be repeated until the CQA Officer accepts the results.

2.5 Marking

Each roll of geomembrane supplied to the site will be marked with the following information:

1. Name of manufacturer
2. Product type and identification number (if any)
3. Batch (lot) number
4. Nominal product thickness
5. Date of manufacture
6. Roll number and dimensions

2.6 Delivery, Handling, and Storage of Geomembrane Rolls

Transportation to the job site, unloading and on-site handling of the geomembrane rolls are the responsibility of the Installer. The geomembrane will be protected, during shipment and during storage, from excessive heat and cold, puncture, water, dirt, mud, grease, cutting, mechanical abrasions and other damaging or deleterious conditions. The geomembrane rolls will be protected from long-term ultraviolet exposure, prior to actual installation at the site. The Installer will be responsible for assuring that the equipment and methods employed to handle the geomembrane rolls pose no risk of damage to any site materials.

Damaged rolls will be separated from undamaged rolls and stored at a location designated by the CQA Officer until final disposition of material is determined. The CQA Officer will be the final authority on determination of damage.

3.0 CONSTRUCTION - GENERAL REQUIREMENTS

This section describes the general QA/QC requirements applicable to the installation and testing of the geomembrane used for constructing the disposal cell. Section 4.3 of this document describes the installation and testing requirements for geomembrane welds.

This section includes discussions on requirements for testing; subgrade earthwork prior to geomembrane placement; geomembrane placement; repairing of geomembrane defects (non-weld related only); and requirements applicable to other materials in contact with the geomembrane.

3.1 Testing Requirements

This subsection describes the test methods, sampling procedures and frequencies, and the role of the Installer in performing the testing requirements as they pertain to geomembrane installation.

3.1.1 Test Methods

Samples will be collected by the CQA Officer at the rate of one sample per lot per shipment of geomembrane rolls to the job site. If there are more than ten rolls in the same lot for a single shipment, then one roll will be sampled for every ten rolls or fraction thereof in that shipment.

Samples will be three feet long by the full width of the roll and will not include the first three feet of any roll. Since machine direction for geomembrane rolls is the direction that the material comes off the roll, *machine direction for any sample will always be along the three-foot-length dimension of the sample.*

Table 3-1 lists the properties and test methods to be performed on geomembrane roll samples. Test results for all specimens will be evaluated on *both average* values and *individual* specimen results. The specifications and methods used in evaluating the results are discussed in Section 3.1.3. Unless specified otherwise, preparation of sample specimens will be performed in accordance with the referenced test methods defined in Table 3-1.

Results for dimensional stability, tear resistance, and each of the tensile property tests will be reported for *both machine* and *cross* direction. Dimensional stability results will be expressed in terms of *machine* and *cross* direction or *length* and *width*.

TABLE 3-1
GEOMEMBRANE TESTS METHODS

<u>PROPERTY</u>	<u>TEST METHOD</u>
Carbon Black Content	ASTM D1603
Carbon Black Dispersion ¹	ASTM D3015
Peel Adhesion, FTB ²	ASTM D413
Bonded Seam Strength	ASTM D3083
Dimensional Stability ^{2,3}	ASTM D1204, to 212°F, 15 minutes
Hydrostatic Resistance	ASTM D751, Method A, Procedure 1
Melt Index	ASTM D1238, Condition E (on finished sheet, not base polymer)
Water Absorption	ASTM D570
Specific Gravity ²	ASTM D792, Method A
Puncture Resistance	FTMS 101B, Method 2031 <i>and</i> FTMS 101C, Method 2065
Tear Resistance ^{2,3}	ASTM D1004, Die C
Environmental Stress Crack ²	ASTM D1693, as Modified in Appendix A
Tensile Properties ^{2,3}	ASTM D638, Type IV Specimens (at two-inch-per-minute extension rate)
o Modulus of Elasticity	
o Yield Stress	
o Yield Elongation	
o Break Stress	
o Break Elongation	
Gauge Thickness ²	ASTM D1593, Para 9.1.3 or ASTM 374
Hardness	ASTM D2240
Volatile Loss	ASTM D1203 or Matrecon Test, Method 1, Appendix F (after immersion)
Resistance to Soil Burial ²	ASTM D3083, as Modified in Appendix A
o Tensile Strength at Yield	or <i>Certification</i> from the supplier
o Tensile Strength at Break	that material will not be affected
o Elongation at Yield	by biodegradation
o Elongation at Break	
o Modulus of Elasticity	

Note: All methods (including test/flow rates, temperatures, pressures, residence times, other conditions, etc.), laboratory CQA data and interpretation of test results are subject to review and approval by an Independent Testing Engineer.

¹Use Section 2.1.6 for evaluating results with no heating or melting of samples allowed under any circumstances.

²Tests and values are from Table 5 of NSF "Standard Number 54 - Flexible Membrane Liners" (1990 Revision).

³Tests are to be performed and results are to be reported for *both machine and cross* direction.

3.1.2 Role of Testing Laboratories

The Installer will be responsible for performing the tests on samples as described in Section 3.1.1. Results of tests performed will be reported to the CQA Officer.

Retesting of geomembrane rolls, because of failure to meet any of the specifications of Section 3.1.3, can only be authorized by the CQA Officer.

3.1.3 Procedures for Geomembrane Roll Test

Table 3-2 lists the acceptance specifications for 80-mil geomembrane for *both average* (for those tests where more than one specimen is tested) and *individual* specimen values. For tests in which *both machine* and *cross* direction are reported, each result must meet the listed specification. For tests such as carbon black content and dispersion, dimensional stability, composition, and melt index where only a single specimen is tested, the following procedure will be used for evaluating results:

1. If the value meets the stated specification, then the roll, the lot, and, if applicable, the entire shipment will be accepted for use as liner at the site.
2. If the result does not meet the specification, then the roll and the lot will be retested on samples either from the original roll sample or from another sample collected by the CQA Officer, or his representative, and forwarded to the Installer. For retesting, two additional tests must be performed for the failed test procedure. If both of the retests are acceptable, then the roll and lot will be deemed acceptable. If either of the two additional tests fail, then the roll and lot are unsuitable without further recourse.

For tests methods requiring more than one specimen, results of the testing program will be interpreted and used as follows:

- a. If both the average and individual specimen values meet the respective values in Table 3-2, then the roll and the lot will be accepted for use at the site. If the sample represents all rolls from an entire shipment, then the entire shipment is deemed acceptable.
- b. If any of the average values or individual specimen values do not meet the limits, then the roll, lot, and if applicable the shipment will be considered unsuitable for use. The Installer then has the following choices:

TABLE 3-2
80-MIL GEOMEMBRANE ACCEPTANCE SPECIFICATIONS

<u>Property</u>	<u>Number of Specimens Per Test¹</u>	<u>Unit</u>	<u>Criterion</u>	<u>Value</u>	<u>Minimum Value for Specimen</u>	<u>Maximum Value for Specimen</u>
Carbon Black Content	1	% by wt	Range	2.10 - 2.50	2.10	2.50
Carbon Black Dispersion	1	N/A	Range	A-1, A-2	N/A	N/A
Dimensional Stability	1	%	Max Change	±2	-2	+2
Hydrostatic Resistance	5	psi	Average ²	≥650	585	N/A
Melt Index	1	g/10 min	Range	0.15 - 0.60	0.15	0.60
Water Absorption	1	% by wt	Max Change	0.1	N/A	0.1
Specific Gravity	3	N/A	Average ²	≥0.940	0.935	0.950
Puncture Resistance	3	lbs	Average ²	≥350(≥70) ^a	315(60) ^a	N/A
Tear Resistance ³	3	lbs	Average ²	≥49	40	N/A
Environmental Stress Crack	10	hrs	No Failures	N/A	1500	N/A
Tensile Properties ³						
o Modulus of Elasticity	5	psi	Average ²	≥80,000	72,000	N/A
o Yield Stress ⁴	5	ppi width	Average ²	≥160	140	N/A
o Yield Elongation	5	%	Average ²	≥13	10	N/A
o Break Stress ⁵	5	ppi width	Average ²	≥300	240	N/A
o Break Elongation	5	%	Average ²	≥500	450	N/A
Hardness (Shore D)	3	SI	Average ²	≤60	54	66
Volatile Loss	1	% by wt	Max Change	0.1	N/A	0.1
Gauge Thickness	5	mils	Average ²	≥80	76	92
Resistance to Soil Burial						
o Tensile Strength at Yield	1	%	Max Change	10	N/A	10
o Tensile Strength at Break	1	%	Max Change	10	N/A	10
o Elongation at Yield	1	%	Max Change	10	N/A	10
o Elongation at Break	1	%	Max Change	10	N/A	10
o Modulus of Elasticity	1	%	Max Change	10	N/A	10

¹Column shows the number of individual specimens that are tested for reporting the results of the referenced ASTM procedure.

²Expressed as the arithmetic mean.

³Test performed in *both machine* and *cross* direction.

⁴Values given correspond to yield stress of 2000 psi for *either machine* or *cross* direction.

⁵Values given correspond to break stress of 3750 psi for *either machine* or *cross* direction.

^aValue in parenthesis represents value for test method FTMS 101C, Method 2065. (*Note: Test method FTMS 101B, Method 2031 must be run as well for Puncture Resistance.*)

- i. The Installer may request that another round of tests be performed on samples collected by the CQA Officer and tested by the Installer. If this option is selected, then the average value for the purpose of determining acceptance will be based on the average value of all specimens tested, including those from the failed round. (*Note: this applies even if retesting is being done because of failure to meet the limits for individual specimen values.*) Individual specimen values will be based only on those obtained from the retesting.
- ii. The Installer can withdraw the rolls for use as the liner at the site. Once withdrawn, the same rolls may not be resubmitted for use.

3.2 Earthwork

The Earthwork Contractor (EWC) will be responsible for preparing the subgrade soil in accordance with the plans and specifications for the installation of the geomembrane (i.e., both the primary and secondary liners).

After proof-rolling, surfaces to be lined will be smooth and free of debris, roots, and angular or sharp protruding rocks larger than three-quarters ($3/4$) inches in diameter and to a depth of three (3) inches of the subgrade. No protrusions larger than three-eighths ($3/8$) inch above the prepared surface will be allowed. All fill shall consist of well-graded material free of organics, trash, clayballs and other deleterious matter. The surface shall be compacted in accordance with design specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subgrade without causing rutting or other deleterious effects.

It is the Installer's responsibility to assist in the coordination of his activities with those of the EWC. The Installer will be held fully responsible and liable for additional costs incurred by the Owner as a result of the Installer failing to perform his duties in accordance with any established schedule.

The EWC shall protect the subgrade from desiccation, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the CQA Officer) installed over the completed subgrade until such time as the placement of geomembrane liner begins. Subgrades found to have desiccation cracks greater than $1/2$ inch in width or depth, or which exhibit swelling, heaving or other similar conditions will be replaced or reworked by the EWC or general contractor to remove such defects.

3.2.1 Surface Acceptance

The Installer will provide the CQA Officer with a written acceptance of the surface scheduled to be lined. This acceptance will be limited to an amount of area that the Installer is capable of lining during a particular work shift. Subsequent repairs to the subgrade and the surface, not scheduled by the Installer to be lined, will remain the responsibility of the EWC.

3.2.2 Crest Anchorage System

The anchor trench will be excavated by the EWC to lines and widths shown on the engineering plans prior to geomembrane placement. Excavation of anchor trenches in clay soils (susceptible to desiccation) should be limited to the distance required for that day's liner placement.

Corners of the anchor trench will be rounded where the geomembrane adjoins the trench.

3.2.3 Final Inspection

Immediately prior to liner installation of a given area, the CQA Officer and Installer will inspect the subgrade a final time to verify it is free of desiccation cracks, moisture seeps, soft spots, roots, sharp stones, large clay clods and other abrupt changes in grade.

The Installer is responsible for identifying to the CQA Officer any soil condition that may require repair work. Special care will be taken to ensure the soil surface is maintained in an acceptable condition to the Installer. Geomembrane will not be installed in muddy or ponded areas. The soil surface will be examined daily by the Installer and CQA Officer to evaluate the subgrade conditions.

3.3 Placement

3.3.1 Location and Panel Layout Drawing

A panel layout drawing will be supplied by the Installer and submitted for approval to the CQA Officer at least three weeks prior to liner placement. The geomembrane will be installed in the disposal cell according to the panel layout drawing, as approved or modified. In addition, the Installer will provide a schedule for installation. The Installer will identify geomembrane rolls by number on the as-built layout drawing, indicating panel configuration, weld locations, destructive/non-destructive test locations, repair and any other test locations.

3.3.2 Weather Conditions

No geomembrane will be placed at ambient temperatures below 34°F (1°C) or above 95°F (35°C) unless specifically authorized by the CQA Officer. In addition, geomembrane will not be placed during any precipitation event. The Installer will document that the above conditions are fulfilled and will inform the CQA Officer, prior to proceeding, if any of the above conditions cannot be satisfied. The CQA Officer, with concurrence from the Installer, will determine whether installation should be stopped or postponed.

3.3.3 Method Of Placement

The Installer will document the following:

1. Equipment employed for installation will not damage the geomembrane by handling, excessive heat, leakage of hydrocarbons, or by other means.
2. The prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and that it is still acceptable on the same day of geomembrane placement.
3. Personnel working on the geomembrane do not smoke, wear damaging clothing, or engage in other activities which could damage the geomembrane.
4. Method used to unroll the geomembrane will not cause scratches or crimps in the geomembrane.
5. Method used to place the rolls minimizes wrinkles (especially wrinkles between adjacent panels).
6. Adequate temporary loading or anchoring (continuously placed, if necessary), will not damage the geomembrane.

Should any of the above conditions not be satisfied, the Installer will notify the CQA Officer and await authorization before proceeding.

3.3.4 Damages

The Installer will examine each roll for damage after placement and prior to welding, as described in Section 4.2.5. The Installer and ITE will inform the CQA Officer as to which rolls, or portions of rolls, should be rejected or repaired. Damaged rolls or portions of rolls which have been rejected will be marked for removal and recorded by the CQA Officer. The Installer is responsible for removing such rolls from the site.

3.4 Defects and Repairs

This section applies to all defects and repairs resulting from examinations, tests, or visual observations performed on the geomembrane material itself and on the welds used to adjoin panels in the field.

3.4.1 Identification

All welded and non-welded areas of the geomembrane will be examined and documented by the Installer for identification of defects, holes, blisters, undispersed raw materials, and signs of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the Installer will clean the geomembrane surface at the time of examination. The geomembrane surface will be swept with a broom, and washed by the Installer if dust or mud inhibits examination.

3.4.2 Evaluation

Locations that fail the non-destructive tests, observations, examinations, or the destructive tests identified in this specification will be marked by the ITE and repaired by the Installer.

Work will not proceed (e.g., using materials that will cover locations) on areas that have been repaired until passing laboratory test results are available.

3.4.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test will be repaired. Several procedures are acceptable for repairing these areas. The final decision as to the appropriate repair procedure will be determined by both the Installer and the CQA Officer, prior to commencement of such work. Acceptable procedures include the following:

1. *Patching* - used to repair holes, tears, pinholes, blisters, undispersed raw materials, and contamination by foreign matter.
2. *Grinding and rewelding* - used to repair small sections of extruded welds.
3. *Capping* - used to repair large lengths of failed welds.
4. *Topping* - used to repair areas of inadequate welds, that have an exposed edge.
5. *Strip Patching* - used to repair large lengths of fusion welds (removal of bad weld, followed by welding a strip of new material).

Other procedures may be used at the recommendation of the Installer if authorized by the CQA Officer. The repair procedures, materials, and techniques will be approved in advance of the specific repair by the CQA Officer and Installer prior to commencement of any repairs. At a minimum, the following provisions will be satisfied:

1. Patches or caps will extend at least six (6) inches beyond the edge of the defect, and all corners of patches will be rounded.
2. The geomembrane below large caps will be cut if necessary, to avoid water or gas collection between the two sheets.

3.4.4 Examination of Repairs

Each repair will be numbered and logged by the Installer. Each repair will be non-destructively or destructively tested in accordance with the provisions of the respective section of this plan under which the repair is required. Repairs that pass the testing identified above will be deemed repaired. Large caps will be destructively tested if of sufficient length (i.e., ≥ 350 lineal feet).

Repairs that fail will be redone and retested until a passing result is obtained. The Installer will observe and perform all non-destructive testing of repairs and will document the number of each repair, the date, and the test result.

3.4.5 Large Wrinkles

Following completion of liner welding (or when welding of a large area of the liner is completed), the Installer will examine geomembrane wrinkles. The Installer and the CQA Officer will determine which wrinkles should be cut and welded. The weld will be done in accordance with the equipment and procedures described in Section 4.2 and 4.3.6, respectively, and it will be subject to the test provisions of Sections 4.4 (field non-destructive testing) and 4.5 (laboratory destructive testing).

3.5 Materials In Contact With Geomembranes

3.5.1 Anchor Trench System and Backfilling

The geomembrane anchor trench for the primary liner will be excavated by the EWC, unless otherwise specified, to the lines and grades shown on the plans and specifications.

3.5.2 Sumps and Appurtenances

The CQA Officer will document that the following requirements are met:

1. Extreme care is taken while welding around appurtenances, inasmuch as nondestructive and destructive testing cannot be performed in these areas.
2. The geomembrane has not been visibly damaged while making connections to sumps and appurtenances.

3. Installation of the geomembrane in the sump and appurtenance areas and connections of geomembranes to sumps and appurtenances have been made in accordance with the approved engineering plans.

4.0 CONSTRUCTION - FIELD WELDS

This section covers the QA/QC procedures for welding geomembrane panels into a continuous liner. The QA/QC Plan for installation of geomembrane at the APCM Landfill includes 100 percent nondestructive testing to detect openings or gaps between geomembrane sheets at the field welds. In addition, destructive testing will be performed at regular intervals for determining the strength and manner of field-weld failure (i.e., in both shear and peel modes). A coupon die and press for ASTM test methodology will be used to produce precise weld coupons in the field (for both field and laboratory testing) for tensile, shear, and peel testing.

4.1 Weld Layout

In general, welds will be oriented parallel to the line of maximum slope so that they are oriented along (not across) the slope. In corners and at other oddly-shaped geometric intersections, the number of welds will be minimized. No horizontal welds will be allowed on the slopes unless otherwise authorized by the CQA Officer or explicitly shown on the engineering plans. Horizontal welds on the cell base of geomembrane installation should be at least five (5) feet from the toe of the slope.

A weld numbering system comparable to and compatible with the geomembrane roll numbering system will be established at the Pre-Construction Meeting.

4.2 Welding Equipment

Approved processes for field welding are extrusion fillet welds and dual hot wedge welds. *Extrusion fillet welds will be used solely for repairs, at oddly-shaped geometric corners, and around appurtenances.* No other processes will be used without prior written authorization from the CQA Officer. Only equipment which has been specifically approved by make and model will be used.

4.2.1 Extrusion Fillet Process

The Installer will meet the following requirements regarding the use, availability, and cleaning of extrusion welding equipment to be used at the job site:

1. One spare operable welding device will be maintained on site at all times.

2. The geomembrane will be protected in areas of traffic to prevent damage.
3. The extruder barrel will be cleaned and purged of all heat-graded extrudate prior to beginning welding and whenever welding operations stop.
4. Equipment generators will be placed on a smooth base in such a manner so as not to damage the geomembrane. Similarly, a smooth insulating plate or a piece of fabric will be placed beneath the hot equipment after usage. (These requirements apply to automated devices used for the majority of roll-to-roll welds and to hand-held extrusion welding equipment used for welding of geomembranes to the leak-detection/leachate collection sumps, and other appurtenances and penetrations of the liner.)

The Installer will provide documentation to the CQA Officer regarding the quality of the extrudate used in the welding apparatus. At a minimum, the extrudate will be compatible with the base liner material and contain the same grade and quality of polyethylene resin used in the base liner material.

4.2.2 Dual Hot Wedge Process

The Installer will meet the following requirements regarding the use, availability, and cleaning of equipment used at the job site:

1. An automated vehicular-mounted type of apparatus will be used.
2. The welding apparatus will be equipped to continuously monitor applicable temperatures and pressures.
3. One spare operable welding device will be maintained on-site at all times.
4. The geomembrane will be protected in areas of heavy traffic to prevent damage.
5. The edge of the cross welds will be ground to a smooth incline (top and bottom) prior to welding.
6. The electric generator for the equipment will be placed on a smooth base in such a manner so as not to damage the geomembrane. Similarly, a smooth insulating plate or piece of fabric will be placed beneath the hot equipment after usage.
7. A movable/temporary protective layer may be used directly below geomembrane overlaps to prevent buildup of water and/or moisture between the geomembrane sheets prior to welding.

4.3 Initial Requirements

4.3.1 Personnel Qualifications

All personnel performing welding operations will be qualified by successfully passing welding tests for the type of welding equipment to be used, as described in Section 4.2. At least one welder will have experience welding a minimum of 1,000,000ft² of polyethylene geomembrane using the same type of welding apparatus to be used at the APCM Landfill. The most experienced welder, or the "master welder", will have direct supervisory responsibility at the job site over less experienced welders.

The Installer will provide a list of proposed welding personnel and their experience records to the CQA Officer for review and approval prior to job commencement.

4.3.2 Weather Conditions

The range of weather conditions under which geomembrane welding can be performed are as follows:

1. Unless otherwise authorized in writing by the CQA Officer, no welding will be attempted or performed at ambient temperatures below 34°F (1°C) or above 95°F (35°C).
2. Between ambient temperatures of 34°F (1°C) and 50°F (10°C), welding will be performed only if the geomembrane is preheated by either sun, a hot air device, or a heated enclosed area, provided there is no excessive ambient cooling resulting from high winds.
3. Above 50°F (10°C), no preheating of the geomembrane is required.
4. Geomembrane will be dry.
5. Welding will not be performed during any precipitation event unless the Installer erects a shelter, satisfactory to the CQA Officer, to protect the geomembrane areas from water.
6. Welding will not be performed in areas where ponded water has collected below the surface of the geomembrane.

If the Installer requests to use welding methods at ambient temperatures below 34°F or above 95°F, the Installer will demonstrate that the methods and techniques used to perform the welding yields welds that are equivalent to those produced at ambient temperatures between 34°F and 95°F, and that the overall quality of the geomembrane is not adversely affected. The Installer will document the following items:

1. Ambient temperatures at which welding is performed, as well as geomembrane surface temperature and weld barrel temperature, will be recorded hourly during placement and welding.
2. Any precipitation event occurring at the site, including the time of such occurrence, the intensity, and the amount of the event.

The CQA Officer will advise the Installer if any of the weather conditions are not as required. The CQA Officer and the Installer will determine whether installation should be stopped or postponed.

4.3.3 Overlapping and Temporary Bond

The following procedures will be used for overlapping and temporary bonding of geomembranes:

1. Panels of geomembranes have a finished overlap of a minimum of four (4) inches for extrusion welding and fusion welding; but, in any event, sufficient overlap will be provided to allow for a peel test on the weld.
2. No solvents or adhesives will be used on the geomembranes unless the product has been approved in writing by the CQA Officer. Approval can only be obtained by submitting samples and data sheets to the CQA Officer for testing and evaluation.
3. Procedures used to temporarily bond adjacent geomembrane rolls should not damage the geomembrane. In particular, the temperature of the hot air at the nozzle of any spot welding apparatus will be controlled such that the geomembrane is protected at all times against potential damage.

The Installer will log all data and information for the above requirements including, at a minimum, operating temperatures of hot air spot welding devices used on the job site.

4.3.4 Trial Welds

Trial welds will be made on fragment pieces of geomembrane to document that welding conditions are adequate. Such trial welds will be made at the beginning of each welding period for each welding apparatus used that day. Per ASTM D-4437, trial welds will be at least 10 feet long and made under the same conditions as actual welds.

The trial welds will first be examined for squeeze-out, footprint, pressure, and general appearance by the Installer. Two adjoining specimens, each two (2) inches, will be cut from the trial weld sample by the Installer. The Installer will subject the specimens to a field Film Tearing Bond peel test. At least three (3) specimens must pass in peel and one (1) in shear to be deemed an acceptable trial weld for a given welding device and operator.

The break is Film Tearing Bond and the following minimum values must be attained:

Shear Strength	160 ppi
Peel Adhesion (dual hot wedge fusion weld)	120 ppi
Peel Adhesion (extrusion fillet weld)	104 ppi

The welding apparatus and welding technique will be adjusted as necessary if a specimen fails. If the weld fails any of these examinations, it will be repeated until satisfactory welds are obtained. A field tensiometer will be employed for such testing having the following specifications:

1. Load range of 0-500 lbs.
2. Preset 2" or 20" per minute.
3. Digital readout in 5 lb increments.
4. A peak-hold function.
5. 110 volt, 3 amps.

A sample from each test weld must be retained and labeled with the date, ambient temperature, number of welding unit, welder, and a pass or fail description. One half of the sample must be given to the FMLI and the other shall be retained by Ford.

4.3.5 Weld Preparation

The following conditions will be met for welds covered by this plan:

1. Prior to welding, the weld area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material.
2. If grinding of a weld-overlap is required, the grinding process will be completed in accordance with the Installer's QA/QC Plan and within one (1) hour of the welding operation in a way that will not damage the geomembrane or cause excessive striation of the geomembrane surface.
3. Welds will be aligned so as to minimize the number of wrinkles and "fishmouths".

4.3.6 General Welding Procedures

Unless otherwise specified, the general welding procedures to be used by the Installer for each of the geomembrane installations covered by this plan will be as follows:

1. For fusion welding, a movable/temporary protective layer of plastic may be required to be placed directly below each overlap to be welded. This should prevent any moisture buildup between the sheets to be welded.
2. If required, a firm substrate will be used to achieve proper support for welding.
3. Fishmouths or wrinkles at the weld overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles will be welded, and any portion where the overlap is inadequate will be repaired with an oval patch or a patch of the same geomembrane (including thickness) extending a minimum of six (6) inches beyond the cut in all directions.
4. If welding operations are to be conducted at night, adequate illumination will be provided by the Installer.

5. Welding will be done under conditions which will minimize or eliminate overlap beads, beads on top of beads, and sharp creases on the bottom of welds.
6. Welding on horizontal surfaces must commence in an effort to reduce wrinkles and fishmouths at the weld interface. Welding will extend to the outside edge of panels.

4.4 Non-Destructive Testing

The entire length of each weld will be nondestructively tested using one of the methods described in this section. The integrity of the welds will be determined by nondestructive testing methods; testing must be done as welding progresses. Weld strengths will be determined by destructive testing methods that are described in Section 4.5. Failure of any of the nondestructive tests will require the repair of the failed section in accordance with the procedures outlined in Section 3.4.

Nondestructive testing, as described in this section will be performed on welds for all geomembrane installations covered by this plan. The air pressure testing method, described in Section 4.4.2, is applicable only to dual hot wedge welds and cannot be used on fillet extrusion welds. The Installer will perform the following:

1. Perform, or observe, all nondestructive weld testing and examine all welds for squeeze-out, footprint, pressure, and general appearance. Failure of these criteria will be deemed a failed weld, and repair or reconstruction will be required.
2. Document location, date, test unit number, name of tester, and outcome of all nondestructive testing.
3. Inform the CQA Officer or his representative of any required repairs, and perform them.

Determination of test results will be handled in accordance with the provisions of Section 4.5.5.

4.4.1 Vacuum Box Test

Vacuum box testing equipment will meet the following minimum standards for use at the APCM Landfill:

1. A five-sided vacuum box with an open bottom, a clear viewing panel on top, and a pliable gasket attached to the bottom.
2. A steel vacuum tank and pump assembly equipped with a pressure controller and with pipe connections capable of maintaining a vacuum of 26 inches of Hg.
3. A vacuum gauge on the tank with an operating range of 0 to 30 inches of vacuum, and a vacuum gauge on the vacuum box with an operating range of 0 to 20 inches of vacuum.

The following procedure will be used in performing the vacuum box test:

1. Welds to be tested will be clean and free of soil and foreign objects which might prohibit formation of a good seal between the vacuum chamber and the geomembrane.
2. Energize the vacuum pump and reduce the tank pressure to approximately 24 inches (Hg) vacuum.
3. Wet a strip of geomembrane approximately twice the size of the vacuum box with a nonalkaline soapy solution.
4. Place and center the vacuum box with the gasket in contact with the geomembrane surface over the wetted area of the weld.
5. Applying a normal force to the top of the vacuum box, close the bleed valve and open the vacuum valve. Check to make certain that a tight seal is created between the geomembrane and the vacuum box. A minimum of five (5) inches of vacuum will be applied for testing, with a maximum testing pressure of ten (10) inches of vacuum.
6. With the vacuum drawn, examine the geomembrane weld (through the viewing port) for bubbles resulting from the flow of air through the weld.
7. Remove the vacuum box by first closing the vacuum valve and opening the bleed valve. Proceed to step 8 if bubbles appear in Step 6. If no bubbles appear in step 6, then proceed directly to step 9.
8. If bubbles appear through the geomembrane, the defective area will be marked with an appropriate device for repair, in accordance with the provisions of Section 3.4.2.
9. Move the vacuum box along the weld to be tested, overlapping the previously tested area by no less than three inches.

4.4.2 Air Pressure Testing

The following test procedures are applicable only to dual hot wedge welds. The equipment for performing the test should meet the following minimum requirements:

1. An air compressor equipped with a pressure gauge and regulator capable of producing and sustaining a pressure between 25 to 30 psig, and mounted on a cushion to protect the geomembrane surface.
2. Fittings, rubber hose, valves, etc. to operate the equipment and a sharp hollow needle, or other approved pressure feed device. Air pressure testing will be performed in accordance with the following procedure:

- i. Seal both ends of the weld to be tested.
- ii. Insert needle or other approved pressure feed device into the air space between the welds.
- iii. Energize the air compressor to a pressure of 25-30 psig. Close the valve and sustain the pressure for approximately five minutes.
- iv. If after five minutes pressure loss exceeds 2 psig or if the pressure does not stabilize within the five-minute period, the weld is deemed a failure and the leak will be located by using the vacuum box method described in Section 4.4.2.
- v. If pressure loss does not exceed 2 psig, then proceed to the next weld for testing.

4.5 Destructive Testing

Destructive weld testing will be performed on welds for the liner. Destructive weld testing is performed to determine the strength of the weld in both shear and peel failure modes. The Installer will test weld samples and verbally transmit results to the CQA Officer within 24 hours after receipt of samples. Written results will be forwarded to the CQA Officer within 48 hours of the receipt of the sample. All samples for testing will be sent by overnight delivery service by the Installer to the laboratory.

4.5.1 Location and Sampling Frequency

The CQA Officer will select locations to cut weld samples for laboratory testing. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential causes of an imperfect weld.

The minimum frequency of sample collection will be one test location per every 500 lineal feet of weld length. This minimum frequency is to be taken as an average for the entire disposal cell.

4.5.2 Sampling Procedure

The Installer will cut samples, at intervals identified above, for both field and laboratory destructive testing. Samples will be cut by the Installer as welding progresses. For each sample location, the Installer will document and perform the following:

1. Assign a sample number and mark accordingly.
2. Record sample location on panel layout drawing.
3. Record the reason for collecting the sample by sample number (e.g., as part of statistical testing program, suspicious weld, etc.).
4. Note on the sample, for the peel test, which geomembrane is the top and which is the bottom with respect to welds performed using dual hot wedge fusion weld techniques.

The laboratory sample will be sixteen (16) inches wide by thirty-six (36) inches long with the weld centered lengthwise. The sample will be cut by the Installer into three parts and

distributed as follows:

1. A 16-inch by 12-inch sample will be cut and retained by the Installer.
2. A 16-inch by 12-inch sample will be cut and given to the CQA Officer for record storage.
3. A 16-inch by 12-inch sample will be cut and transmitted to the Installer's laboratory.

All holes cut into the geomembrane resulting from destructive weld sampling will be immediately repaired by the Installer in accordance with the repair procedures described in Section 3.4. The integrity (non-destructive testing) of the new weld in the repaired area will be tested in accordance with the requirements of Section 4.3.5.

4.5.3 Laboratory Test Methods

Laboratory testing of the weld samples described in Section 4.5.2 will be performed by the Installer or by a laboratory contracted by the Installer. Samples cut out from production welds will be evaluated in general accordance with ASTM D413 methodology, which stipulates that at least five (5) specimens will be tested in shear and five (5) specimens will be tested in peel. Samples will be cut in alternating order (e.g., shear, peel, shear, peel, etc.) and should also be tested in the order of cutting, to determine if any trend in weld quality along the length of the sample exists. All specimens will be cut in one-inch wide strips to ensure that the weld does not exceed the test gauge length of the specimen. Four (4) of the five (5) replicate test results must pass.

The following tests will be performed on each weld sample submitted to the Installer:

1. *Shear maximum tension* is the load per unit width of a one-inch-wide specimen expressed in pounds per inch of width, in accordance with ASTM D3083, using the samples described above. Tests will be conducted on five specimens.
2. *Shear elongation at break* is the extension at break expressed as a percentage of the initial distance between the edge of the fused track and the nearer grip. This distance should be the same on both sides of the weld and is usually one (1) inch. No referenced ASTM test exists for this procedure as defined; however, the specimen will be elongated to a maximum of 100 percent with any failures of individual specimens noted. For specimens that fail below 50 percent elongation, the value that failure occurred at will be noted on the results.
3. *Peel maximum tension* is the maximum load per unit width of specimen recorded during the peel test in accordance with ASTM D413.
4. *Peel weld separation* estimates the area of weld interface separation expressed as a percentage of the original area.

In addition, for both the weld shear and peel tension tests, an indication will be given for each specimen tested which defines the locus of the failure. The loci will be defined by using the following designations (for unsupported geomembranes):

<i>T</i>	Break occurs in the upper geomembrane
<i>B</i>	Break occurs in the lower geomembrane
<i>G</i>	Break occurs in the geomembrane when the upper and lower geomembrane cannot be identified
<i>P</i>	Complete peel separation occurs

Note: The P may be followed by another designation if the specimen does not peel completely. For example, PB would indicate some peel separation followed by a break in the bottom geomembrane.

For welds made with dual hot wedge (or fusion) type welds, the peel parameters will be presented for both tracks. Figures for the track closer to the edge of the bottom sheet (*J*) will be reported first and are followed by figures for the track closer to the edge of the top sheet (*O*). This applies only to samples received from field installations when the top and bottom sheets can be clearly identified.

For the weld shear tests, specimens should be inserted in the test machine with gauge lengths of two inches between each edge of the weld and the adjacent grip. The crosshead speed will be two inches per minute for conventional medium and high density polyethylene. Parameters monitored during the test will be load and crosshead displacement. The test may be terminated when the crosshead has moved two inches.

For the peel tests, specimens will be inserted in the tensile machine so the grips are no closer than one inch to the edge of the weld. The grips may be closer than one inch only if there is insufficient material to allow insertion at this setting. All weld peel specimens will be tested at a two-inch-per-minute crosshead speed.

For shear tests the following values, along with mean and standard deviation where appropriate, will be reported for each specimen tested:

1. Specimen thickness in mils
2. Maximum tension in pounds per inch
3. Elongation at break indicating at what percentage the specimens failed (up to a tested maximum of 100)
4. The locus of failure using the above designations. For peel tests, the following values, along with mean and standard deviation where appropriate, will be reported for each specimen tested:
 - i. Specimen thickness in mils
 - ii. Maximum tension in pounds per inch
 - iii. Weld separation expressed as percent of original weld area
 - iv. Locus of failure

4.5.4 Role of Testing Laboratories

The Installer will be responsible for performing the tests on the destructive test samples as described in Section 4.5.3. Results of tests performed will be reported to the CQA Officer.

Retesting of welds, because of failure to meet any or all of the specifications of Section 4.5.3, can only be authorized by the CQA Officer.

4.5.5 Procedures For Determining Weld Test Failures

The procedures described in this section apply to the testing procedures defined in Sections 4.4 and 4.5 of this document. Procedures for repairing failed welds are described in Section 4.2.4 of this document.

Any weld that shows a discontinuity as the result of the non-destructive testing method described in Section 4.4 will be deemed as having failed. The boundaries of the failed weld are subject to the procedure described below.

Results from the shear and peel tests described in Section 4.5.3 will be evaluated by the criteria tabulated in Table 4-1, which are based on the values for material properties for yield stress from Table 5 (for HDPE type geomembranes) of the National Sanitation Foundation document "Standard Number 54 - Flexible Membrane Liners" (1990 Revision). *Note: Yield stress of the base geomembrane is considered a more representative criterion than bonded weld strength. All of the criteria in Table 4-1 must be met for the weld to be deemed acceptable.*

The Installer has the following two options in determining the repair boundary whenever a weld has failed either nondestructive testing (Section 4.4) or field/laboratory destructive testing (Section 4.5):

1. The weld can be reconstructed between any two previously tested locations having welds that passed.
2. The Installer can trace the welding path to an intermediate location at least ten feet from the point of the failed test in each direction and perform field tests at these intermediate locations. If the field test results are acceptable, then full laboratory samples are taken and tested. If the laboratory tests are acceptable, then the weld is reconstructed between these intermediate locations. If either sample fails, then the process is repeated until acceptable weld tests have been performed in both directions away from the original failed sample location. All retesting of welds, in accordance with this procedure, will use the sampling methodology described in Section 4.5.2 of this document.

All acceptable welds must be bounded by two locations from which samples passing Installer destructive tests have been taken. In cases exceeding 150 feet of reconstructed weld, an additional sample taken from the reconstructed zone must pass destructive weld testing.

The Installer will be responsible for documenting all actions, including test results submitted by the Installer, taken in conjunction with weld testing. The Installer will also be responsible for keeping the CQA Officer informed on weld testing results and welding progress.

TABLE 4-1
80-MIL GEOMEMBRANE WELD ACCEPTANCE SPECIFICATIONS

<u>Property</u>	<u>Number of Specimens per Test</u>	<u>Units</u>	<u>Type of Criterion</u>	<u>Value</u>	<u>Minimum Value for Specimen</u>
Shear Strength	5	ppi width	Average ¹	≥160	155
Shear Elongation	5	%	Minimum	50	50
Peel Strength	5	ppi width	Average ¹	≥128(104)*	115(87)*
Peel Separation	5	% ^a	Maximum	10 ^b	N/A

¹Expressed as the arithmetic mean.

^aExpressed as an estimate of the percent of area of seam interface separation.

^bNo single specimen can have an estimated separation of greater than 10%.

*Value in parenthesis represents value for extrusion fillet weld.

APPENDIX A

PLATE 1

CELL II SECONDARY LINER COMPACTED CLAY REQUIREMENTS

1. Permeability

Coefficient of Permeability (K) $\leq 1 \times 10^{-6}$ cm/sec

2. Dry Density

Dry Density $\geq 90\%$ of the maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D-1557).

3. Moisture Content

Moisture Content ranges from optimum moisture content to 5% higher than optimum moisture content determined by the Modified Proctor Compaction Test (ASTM D-1557).

4. Undrained Shear Strength

Undrained Shear Strength ≥ 1500 psf

APPENDIX B

GUIDELINE FOR HEALTH AND SAFETY PLAN

PART 1: GENERAL

1.1 DESCRIPTION

1.1.1 The Contractor shall develop and implement a detailed written Health and Safety Plan for the Work. The information requirements and guidelines contained in this section will be used as the basis for the Contractor's Health and Safety Plan. The responsibility for development, implementation and enforcement of the Health and Safety Plan lies solely with the Contractor.

1.1.2 The Contractor shall develop and implement all necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury or loss to:

- All employees and subcontractors participating in performance of the Work.
- All components of the Work, and materials to be used or incorporated in the Work, and any equipment to be employed in the execution of the Work, whether on or off site.
- Other property on or adjacent to the project site including trees, shrubs, lawns, sidewalks, pavements, roadways, structures and utilities not designated for removal, relocation, or replacement in the course of construction.

1.2 WORK NOT INCLUDED

1.2.1 The Contractor is not responsible for development and implementation of Health and Safety Criteria for Owner personnel, contractors working under separate contract(s) or any other personnel not employed or contracted by the Contractor to perform the Work.

1.2.2 The Contractor shall not deviate from his Health and Safety Plan unless otherwise authorized by the Owner.

PART 2: SPECIAL CONDITIONS

2.1 RELATED INFORMATION

All work and materials shall be in accordance with the approved Health and Safety Plan.

2.2 SUBMISSION OF PLAN

2.2.1 Upon receipt of the Notice of Contract Award, the Contractor shall submit his Health and Safety Plan to the Owner within seven (7) days of the date of contract award. The Plan shall be signed and dated by the Contractor.

2.2.2 The Owner will review the Contractor's Health and Safety Plan and will transmit his comments to the Contractor. It will be the responsibility of the Contractor to incorporate the Owner's comments into the Health and Safety Plan prior to initiating site work. The Contractor will not be permitted to initiate site work until said comments have been incorporated into the Plan. The approval of the Health and Safety Plan indicates only that the Plan complies with the requirements of this specification and standard plant procedures. It does not imply that all procedures are suitable for the required work. Suitability of the plan for the Work is the responsibility of the Contractor.

PART 3: CONTENT AND IMPLEMENTATION OF HEALTH AND SAFETY PLAN

3.1 CONTENT OF HEALTH AND SAFETY PLAN

3.3.1 The Contractor shall prepare a written Health and Safety Plan which is applicable to all components of the Work. The plan shall be based upon the requirements and guidelines described herein. The Contractor's Health and Safety Plan will apply to all Contractor and Subcontractor personnel. The Contractor may include additional information as appropriate, and utilize any format provided it is neat, clean and complete.

The Contractor shall develop and implement his own Health and Safety Plan that meets, as a minimum, the requirements of:

- Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926).
- United States Environmental Protection Agency (USEPA) Interim Standard Operating Guidelines, Revised September, 1982.
- Safety and Occupational Health Document "Requirements for Hazardous Waste Sites Remedial Action Circular 385-1-192".

In addition, the plan must specify or describe at a minimum, the following information:

- Responsibilities of the Contractor and his/her Health and Safety Coordinator. The name of the Health and Safety Coordinator shall be provided along with his/her qualifications for the position.
- The description of the Work and its component activities and tasks. The Contractor shall refer to the Job Specification for details regarding the Scope of Work.
- Hazard evaluation, including discussion of potential hazards involved with the Work including physical hazards such as, but not limited to, personnel injury, subsidence, noise and natural disasters as well as chemical hazards associated with the waste materials known or suspected in conjunction with the Work.
- Safe work practices and preventive measures to be taken or implemented for each of the potential hazards identified.
- A discussion of proposed environmental and personnel monitoring.
- Personnel protection requirements for specific work areas or specific activities or tasks. These procedures should specify protocol for upgrading the level of personnel protection and environmental or industrial hygiene monitoring to assure personnel safety. The Contractor shall supply all personnel protective equipment, air monitoring instruments, analyses and other safety-related equipment or instruments necessary to

continue work in the event of upgraded levels of personnel protection.

- Personnel and equipment decontamination procedures.
- Training requirements for personnel utilizing personal protective equipment. The Contractor shall provide 40 hours of classroom training supplemented with on-the-job training as required by OSHA in 29 CFR 1910.120 for all personnel who will be working on site prior to their initiating on-site work. Additionally, the Contractor's supervisory personnel shall receive an additional 8 hours of training. The Contractor's training curriculum should include, at a minimum, the following topics:
 - Chemical Hazards
 - Physical Hazards
 - Potential for Exposure on Site
 - Levels of Protection
 - Decontamination Procedures
 - Emergency Procedures/Telephone Numbers
 - Hospital/Infirmary Directions
 - Health and Safety Chain-of-Command
 - Respiratory Checkout
 - Fit Tests
- Personnel assigned to the Work or, as appropriate, to specific activities or tasks.
- Requirements for medical monitoring of site personnel. The Contractor shall use the services of an occupational physician to perform the medical monitoring and surveillance protocol specified in the Health and Safety Recommendations subsection of this technical standard. The Contractor shall submit to the Owner a statement from the occupational physician performing the medical monitoring certifying that the subject employees have the physical ability to perform

their assignments while using respiratory protection.

- Responsibility and procedures for notifying/contacting emergency personnel.
- Procedures for emergency situation assessment, control procedures, emergency equipment, and personnel evacuation.
- Procedures for post-emergency measure including storage, treatment and disposal of hazardous substances, and emergency equipment maintenance, and documentation of emergency events.
- Weekly safety logs and closeout safety report to be maintained by the Contractor.

The Contractor shall provide the Contract Administrator with five (5) copies of the final version of the Health and Safety Plan accompanied by a transmittal letter signed and dated by the Contractor. All Contractor and Subcontractor personnel shall be required to read and initial the approved Health and Safety Plan. The attached OSHA Job Safety and Health Protection Bulletin shall also be posted at the site along with listings of Emergency contact phone numbers.

PART 4: REVISIONS TO HEALTH AND SAFETY PLAN

- 4.1 If at any time during the execution of the Work, the Contractor or Owner determines that the Contractor's Health and Safety Plan does not adequately address the nature or scope of any site-specific hazards or conditions, the Contractor shall revise his/her Health and Safety Plan. The revisions will encompass all work remaining to be done. Specifically, these provisions will apply in the event substantial amounts of hazardous substances or hazardous wastes are encountered at any time during the execution of the Work.
- 4.2 The Contractor shall review and, as appropriate, revise and modify his/her Health and Safety Plan if any hazardous substances or hazardous wastes are encountered during execution of the Work. The revisions shall include, but are not limited to, the following:
 - A description of any new or additional activities, or any re-ordering of the Work, as a result of the presence of hazardous substances or hazardous wastes.

A detailed description of any new or additional hazards posed by the hazardous substances present including toxicity, reactivity, radioactivity, corrosivity and biological activity. Specifically, the revisions will include a discussion regarding the nature and extent of these hazards, the potential routes of worker exposure and symptoms of acute and chronic exposure.

Additional preventive measures including work zone delineation and site access controls as well a personnel and equipment decontamination. The plan will include a map or sketch of the work site showing work zones including support, personnel and vehicle decontamination areas and the exclusion zones.

Any revised emergency or post-emergency measures or procedures.

- 4.3 The Contractor shall submit his/her revised Health and Safety Plan to the Owner at least five (5) working days prior to commencing work in areas suspected of containing hazardous substances or hazardous wastes. The revised plan will be accompanied by a transmittal letter signed and dated by the Contractor.
- 4.4 The Owner will expeditiously review the revised Health and Safety Plan submitted by the Contractor, and transmit his comments to the Contractor. The Contractor shall incorporate these comments into the plan. The Contractor shall provide copies of the revised Health and Safety Plan accompanied by a transmittal letter to the Owner.
- 4.5 The Contractor shall remove any and all obsolete versions of the Health and Safety Plan from circulation throughout the project site. The Contractor shall maintain at least one copy of the previous version on file with the project records.

PART 5: HEALTH AND SAFETY COORDINATION

- 5.1 The Contractor must provide an on-site Health and Safety Coordinator during all activities, appropriately trained and certified for supervisory responsibility in health and safety protection. An alternate Health and Safety Coordinator, with appropriate training, must be designated to serve when the Health and Safety Coordinator is not on site. The Health and Safety Coordinator shall be on site at all times when Work is in progress.

- 5.2 It shall be the responsibility of the Contractor's site Health and Safety Coordinator to ensure that all health and safety requirements are implemented per the approved Health and Safety Plan. The Coordinator will have control over the safe execution of the Contract while in progress. Should for any reason it be determined that the working conditions are unsafe, the Coordinator, at his/her discretion, can terminate the Work. The Coordinator is charged with personnel decontamination and emergency response measures.

The Health and Safety Coordinator will have the authority to act on all health and safety issues and matters, and to establish new controls, procedures or facilities as needed. If the Owner determines that the Contractor's Health and Safety Coordinator is not providing adequate health and safety controls, the Contractor shall provide alternate personnel subject to the approval of the Owner to serve as Health and Safety Coordinator.

- 5.3 The Health and Safety Coordinator shall meet the following minimum qualification requirements:

- Experience in preparation of Health and Safety Plans which have been approved and implemented at hazardous waste sites.
- Minimum of six (6) months experience in monitoring worker safety and occupational exposure at site investigations or clean-ups involving hazardous materials or hazardous wastes.
- Minimum of twenty-four (24) hours work in Level C personal protective equipment.
- Sound working knowledge of Federal and State occupational safety and health regulations, including general construction standards.
- Current certification by the American Red Cross (or other equivalent) in basic first aid and cardiopulmonary resuscitation.
- Forty (40) hours of classroom training plus an additional eight (8) hours of classroom training for supervisory personnel as required by 29 CFR 1910.120. In the event the Health and Safety Coordinator's initial training was provided over one (1) year prior to site Work, the Health and Safety Coordinator must also have an additional eight (8) hours of refresher training.

PART 6: RECOMMENDATIONS FOR IMPLEMENTING HEALTH AND SAFETY PLAN

6.1 GENERAL

The guidelines provided herein address implementation of personnel protection during operations associated with the Work. These recommendations are intended to serve as guidance for preparation and execution of a Health and Safety Plan by the Contractor only and cannot be used as a working document for field use. The Contractor must prepare his own Health and Safety Plan for implementation by the Contractor's personnel that meets requirements specified herein by appropriate government agencies.

6.2 CONTRACTOR'S RESPONSIBILITY

Specifications/guidance presented herein are in addition to or an amplification of procedures and requirements of regulations and documents referenced earlier.

Should any unforeseen or site safety-related factor, hazard, or condition become evident during the performance of work at the site, it shall be the Contractor's responsibility to bring such to the attention of the Owner both verbally and in writing as quickly as possible for resolution. In the interim, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the public and the environment in accordance with the Contractor's Health and Safety Plan.

Should the Contractor seek relief from, or substitution for any portion or provision of his/her Health and Safety Plan, such relief or substitution shall be requested of the Owner in writing, and if approved, authorized in writing.

Any disregard for the provisions of said Health and Safety Plan shall be deemed just and sufficient cause for termination of the contract without compromise or prejudice to the rights of the Contractor.

6.3 PERSONNEL PROTECTION EQUIPMENT

6.3.1 Contractors's Responsibility

The Contractor shall be required to supply and maintain protective clothing and equipment necessary for his personnel. Such protective clothing and equipment must be in accordance with specifications in the Contractor's Health and Safety Plan and

approved by the Contractor's site Health and Safety Coordinator prior to use at the site. The Contractor's site Health and Safety Coordinator is responsible for monitoring conditions at the work site and making determinations as to the necessary for upgrading or modifying the level of protective equipment.

6.3.2 Contingency Equipment

Adequate supplies of Level D personnel protective equipment should be maintained on site to outfit a contingency response team.

In addition, sufficient quantities of Level C protective equipment should be maintained on-site to outfit a contingency response team.

6.3.3 Monitoring Instruments

For the possible presence of organic solvents, both non-specific organic monitors and combustible gas indicators (CGI) should be used to determine immediate hazard to workers. The CGI will indicate potential evolution of methane or other combustible gases. Accordingly, the Contractor's Health and Safety Plan shall establish the appropriate monitoring equipment for use in measuring the presence of specific organics along with the threshold limit value and maximum exposure concentration for each organic compound.

Additionally, oxygen concentration meters should be used to determine the adequacy of atmospheres in confined areas. Sulfide gas indicators should be used to identify hazardous concentrations of sulfide that may escape olfactory detection.

It is recommended that the Contractor's Health and Safety Plan list the atmospheric hazard action level and respective response action for each proposed monitoring instrument.

Regarding the presence of inorganic compounds (e.g., metals), the Contractor's Health and Safety Plan should specify the possible hazards (e.g., creation and dispersion of dust), methods for measuring these hazards and corresponding response actions.

6.4 DECONTAMINATION

6.4.1 Personnel Decontamination

Operations in Level D require no specific exclusion zone or support zone. However it is recommended that the Contractor's Health and Safety Plan include provisions for controlled ingress/egress and cleaning/decontamination of personnel and equipment for the major work areas. Operations in Level C protective equipment require the establishment of a contaminated (exclusion) zone and a support zone, with personnel leaving the exclusion zone undergoing decontamination in the contamination reduction zone prior to entering the support zone. While the specific arrangement of the various zones will depend in part upon the work operations, the prevailing wind direction should be determined to ensure the reduction and support zones are upwind of the Work as much as possible.

The decontamination process consists of sequential washing and/or removal of contaminated articles of clothing.

6.4.2 Equipment Decontamination

Sampling equipment should be decontaminated by washing in appropriate solutions (soap) and rinsing in distilled water. Rinsates shall be collected for appropriate disposal.

Decontamination of earthwork equipment will be required when it is removed from the exclusion zone. Level B decontamination procedures are essentially similar, with the addition of SCBA removed before Station II or tank replacement at Station 9. Rinsates from decontamination shall be collected in drums or tanks at the decontamination site for disposal.

PART 7: MEDICAL SURVEILLANCE PROGRAM

7.1 RESPONSIBILITY

All personnel working at the site must participate in a medical surveillance program. The Contractor is responsible for

providing the medical surveillance program for his/her employees.

7.2 INITIAL MEDICAL EXAMINATION

The Contractor shall use the services of an occupational physician to provide the medical examinations and surveillance specified herein. The name of the physician and evidence of examination of all Subcontractor personnel shall be provided to the Contractor prior to assigning these personnel on site. All such evidence, for both the contractor and all subcontractors, shall be submitted to the Owner for approval prior to assignment of personnel. The physician will certify that the individual has the physical ability to perform his work assignment using respiratory protective devices.

Medical surveillance protocol is the physician's responsibility, but shall meet the requirements of OSHA Standard 29 CFR 1910 for all personnel.

7.3 PERIODIC SURVEILLANCE

Periodic Surveillance examinations shall be performed:

- Annually for all employees participating in medical surveillance program.
- Following an acute overexposure to any toxic or hazardous material.
- Examination will be performed more frequently, if deemed necessary by specialists.

7.4 SUBCONTRACTORS

All subcontractors and their personnel are required to comply with the medical surveillance program. All Subcontractor personnel involved in the Work shall be provided with medical surveillance. The Contractor and all Subcontractors must demonstrate compliance with this requirement to the Owner.

PART 8: PERSONNEL TRAINING

8.1 RESPONSIBILITY

The Contractor is responsible for providing health and safety training to all contractor personnel assigned to the site prior to their assignment to work on this project.

All Subcontractors must also comply with the same training requirements.

8.2 TRAINING PROGRAM

The health and safety orientation training will ensure compliance with the Health and Safety Plan and full "right-to-know" requirements. The training program must consist of 40 hours of documented training for each person (48 hours for supervisors), and must meet the intent of the requirements in 29 CFR, Part 1910.120. The topics listed earlier should be addressed.

PART 9: EMERGENCY CONTINGENCY MEASURES

9.1 EMERGENCY CONTACTS

Primary emergency contacts to be utilized in the event of an emergency on site as part of the work are listed in Table 1. The Environmental Coordinator or his/her appointed representative will serve as the primary contact and should be the first individual notified in the event of an emergency at the number listed below. The Owner should be notified if the Environmental Coordinator cannot be reached.

9.2 TRAVEL DIRECTIONS TO HOSPITALS

Travel directions from the facility to nearby hospitals are as follows:

TABLE 1 PRIMARY EMERGENCY CONTACTS	
Contact	Telephone No.
Center for Disease Control	(day) 404-329-3311 (night) 404-329-3644
National Pesticide Center	800-845-7633